ILLUSTRATED
ELECTRICAL REVIEW
A Journal of Scientific and Electrical Progress.

VOL. 24. No. 16. WEEKLY. | NEW YORK, WEDNESDAY, APRIL 18, 1894. | $3 per Annum. Single Copies, 10 Cents.

Copyright, 1894, by ELECTRICAL REVIEW PUBLISHING COMPANY, 13 Park Row, New York.

Entered at Post Office, New York, as Mail Matter of the Second Class.

VIEWS, NEWS AND INTERVIEWS.

It is reported that the firm of Siemens & Halske are experimenting with an electric plow on the estate of Biesdorf, the property of Mr. Arnold von Siemens.

What is the difference between a rheostat and a resistance? This was the riddle set Mr. Justice Kennedy for solution, says London *Industries*. As a riddle it does not appear very complicated; but when it was fully explained by Mr. Finlay, Q. C., Mr. Bousfield, Q. C., and Mr. Pollard, and also by Sir Richard Webster, Q. C., Mr. Moulton, Q. C., and Mr. Walter, and when the explanations were elucidated and elaborated by Professor S. P. Thompson, Lord Kelvin, Professor Bottomley, Mr. Muirhead, Mr. Mockridge, Dr. A. Muirhead and Dr. Hopkinson on the one hand, and by Professor Jamieson, Messrs. Swinburne, Gott, Jacob, Kempe and Sir Henry Mance on the other, it will be seen what a Sphynxian aspect this horrible conundrum has taken on. It took seven days to discuss this complicated question, and the last day the court sat till six o'clock in a laudable attempt to unravel the mystery, and has now, we believe, gone into chambers or on circuit for an intellectual rest. Mr. Justice Kennedy had only just finished a case about semolina purifiers with nearly the same counsel and witnesses; and if he were an ordinary mortal instead of a judge he would probably give judgment on a duplex purifier throwing dust in the eyes of the court.

It is said that Lord Kelvin has found the duties of the presidency of the Royal Society and of his Glasgow professorship too heavy for his years, and it is believed that he intends shortly to resign the latter office, says London *Lightning*. So much, indeed, he has confided to his friends, but great pressure is being brought to bear upon him to reconsider the matter and retain his professorial chair, at least until he has celebrated his jubilee. He has held the chair of Natural Philosophy since 1846, so that only another two years are necessary to complete the term, which will not be allowed to pass without some testimonial to the great services his lordship has rendered to physical science.

Mr. Ryckman, United States Commissioner to the Antwerp International Exposition, Mr. Coyle, special American press representative, Mr. Dundone, treasurer of the American Exhibitors' Syndicate, Mr. Warren, attorney, and Mr. Muellierro, director of the Pan-American company, with a party of 20 attendants in the American sections, arrived in London recently from New York *en route* to Antwerp. They will install the exhibits from the United States, which number about 600. These displays illustrate the various American industries of which the products are known in Continental cities, and will occupy about 60,000 square feet in the principal departments, as well as in the American building, which will cover 50,000 feet of space in the gardens. A prominent feature of the American department will be the "Plaisance," on the model of the "Midway" in the Chicago World's Fair, in which 29 large exhibitions will be presented, showing almost every type of American life, character and amusement.

The first suit of the kind ever brought in New York State has been begun in the Kings County Supreme Court to determine whether a trolley company is responsible for a fatal accident resulting from a horse becoming frightened by one of its cars. Mrs. Charles Constantine, her two children and a woman were in a village cart in Fishkill, N. Y., on September 12, 1892, when a trolley car came up behind them. Although the cart was not on the railway track, but in the roadway, the motorman as he approached rang his gong so vigorously that Mrs. Constantine's horse became frightened and ran away. The cart collided with a watering cart in the street and Mrs. Constantine's two year old boy, Collins, sustained injuries from which he died the same day. A lawyer was instructed to bring suit for damages against the Citizens' Street Railroad Company, of Fishkill, which owned the car. He found that only one similar action had been brought, and that in Massachusetts, where a railroad company was held responsible under similar circumstances. The lawyer has sued the Fishkill company for $5,000.

National Telephone Apparatus.

We illustrate herewith one of the new switchboards for telephone exchanges which

FIG. 2.—NATIONAL TELEPHONE MANUFACTURING COMPANY'S TELEPHONE SET.

has recently been placed upon the market by the National Telephone Manufacturing Company, of Boston, Mass. This board is a duplicate of one shipped to the National Construction Company, 602 Matthews building, Milwaukee, Wis. The National Construction Company, by the way, has no connection whatever with National Telephone Company, and the board was bought and paid for. The simple and economical features of this switchboard, which is capable of handling 250 subscribers, will be seen at a glance, and they can be manufactured for about one-third the cost of a first-class annunciator board of the same capacity.

FIG. 1.—NATIONAL TELEPHONE MANUFACTURING COMPANY'S SWITCHBOARD.

One of the telephones used in connection with this board is illustrated herewith. It has been generally admitted by good authorities on telephone matters that this compound receiver telephone is the most powerful in use, not only in this country, but in Europe as well. They have been sold in connection with the above switchboard to sub-Bell companies, army officials, universities, colleges and corporations all over the country, and the manufacturers solicit tests with all known receivers.

The demand for these instruments since they were first put on the market has been very large, and the National Telephone Company are so confident as to the excellence of the service which they will render, that they make a point of requesting prospective purchasers to order two sets only at the start, and make their own tests for efficiency. This proposition has a business-like ring to it, and has been productive of most satisfactory results, as wherever two sets of instruments have been put in an order for more has followed.

Electric Lighted Buoys for Mobile Bay.

Captain W. S. Schley, U. S. N., and Lieutenant Commander C. H. West, U. S. N., of the United States Lighthouse Establishment, recently visited Mobile, Alabama, for the purpose of considering a plan to electrically light 25 miles of the dredged channel through Mobile Bay by submarine cables. Although vessels drawing 20 feet of water pass from Mobile to the Gulf of Mexico, the channel is at present insufficiently lighted for night navigation. Experts of the Westinghouse Electric, General Electric and Bishop Gutta-Percha companies are taking much interest in the projected scheme. It is not decided yet whether a direct current or alternating current will be employed. A copper-armored cable is under consideration by the government officials to obviate the injurious effects of induction in steel-armored cables. Should this plant be installed it will be the largest of its kind. The submarine cables at present lighting the bay so efficiently at Sandy Hook, New York Lower Bay, are about seven miles long.

The death is announced of the Russian inventor and electrician, Paul Jablochkoff. In 1877 he produced the now famous arc lamp, then called the Jablochkoff "candle," which was used to light the Avenue de l'Opera, Paris, in 1878.

The Edson Pressure Recording Gauge Receives the John Scott Legacy Medal and Premium.

The Committee on Science and the Arts of the Franklin Institute, Philadelphia, have awarded the John Scott Legacy Medal and Premium to Mr. Jarvis B. Edson, of New York city, for his pressure recording gauge, which has become so well known to steam users. The committee, in its investigation, consulted 33 United States patents bearing on the subject of recording gauges, and rendered a report of which the following is an abstract:

The instrument has been gradually developed through more than 20 years, the first of a series of patents covering the invention bearing date of May 5, 1868 (No. 77,584). The present style of gauge was adopted and patented August 16, 1870 (No. 106,345). The latest patent bears date of December 23, 1890 (No. 443,360), and shows the most improved form of the instrument, which is illustrated herewith.

No other recording gauge is similar in construction, as an inspection of the appended list of letters patent will show. This list substantially covers the ground of recording gauges, and the patents embraced therein were studied by the sub-committee appointed to conduct this investigation.

The Edson instrument affords a written tracing or log of every degree of pressure sustained within a steam boiler, tank, pipe or any reservoir, of water, oil, air, steam or other liquid, to which it is attached, and of the time when such pressure existed. It gives, if continuously applied, a complete biography of a boiler and a correct exhibit of all the work done. The recorder is a good check on night guards, and if regularly kept will show indisputably whether a boiler has been overstrained, and, if so, how often this has happened, the knowledge of which may save many lives and valuable property. The fact of the existence of this continuous and easily interpreted chart will undoubtedly tend to make firemen both careful and proud of their record, while giving to their employers evidence of facts not otherwise obtainable and the best assurance of careful and economical working.

When used in the water departments, the gauge not only verifies the pressure on the mains, but also detects leaks and the opening of hydrants, or any heavy draughts of water for legitimate or illegitimate purposes.

The record can be read at a glance, as the co-ordinates of time and pressure are rectangular and not circular as in most of the other recording gauges. The latter system does not give as clear a picture of the variations of pressure and appertaining parts of time as the former.

The Edson pressure recording gauge has been in service for many years, and a few of the testimonials submitted to the investigating committee clearly show the durability and practical value of the instruments. These testimonials, without exception, exhibit the fact that the gauges have done their work perfectly and to the great satisfaction of their owners, and that continuously, for periods, in some instances, up to 12 years.

Among others the National Transit Company (oil pipe line) has had in service during the last six years about 140 of the Edson instruments, one-half of which are recording from 0 to 800 and as high as 1,500 pounds per square inch. With but one exception, none of these have ever been returned for repairs. The Illinois Steel Company has in constant operation 45 gauges. The list of the patrons of the Edson pressure recording gauge is very long, and the best names are among them, and their evidence as to the efficiency and practical value is, uniformly, highly favorable.

It can, therefore, safely be affirmed that the Edson gauge has proved itself in service to be a reliable and well-made instrument which has successfully stood the severe test of time, and it can safely be recommended to every owner of a steam boiler in the interests of safety and economy.

The recording gauge shows its superior qualities not only in connection with the steam boiler, but also in all cases where fluids are kept under pressure. It is, therefore, very desirable to use in connection with gas and water pipe systems, oil pipe lines and tanks, blast furnaces, etc.

Its extremely close accuracy makes this gauge very valuable in the various industries where uniformity of pressure is indispensable for the best production and highest efficiency of a manufacturing or other plant.

The gauge is mechanically one of the finest pieces of workmanship of its class now in the market, and the fact that it can be used continuously, that is, that it need not be looked after every day, makes it particularly desirable where it would be inconvenient to change records every 24 hours; and the user can be assured that the records will continue in a legible shape whether it receives proper attention or not, which, of course, cannot generally be done in the case of gauges making a circular record.

A large amount of labor has been spent in the perfection of this gauge during the many years that it has been in use, and the fact that the gauge as now made is such an excellent piece of apparatus, warrants the Institute in recommending the award of the John Scott Legacy Premium and Medal to the inventor, Mr. Jarvis B. Edson, for the excellent development of his pressure recording gauge.

THE EDSON PRESSURE RECORDING GAUGE.

Adopted at the stated meeting of the Committee on Science and the Arts, held Wednesday, November 1, 1893.

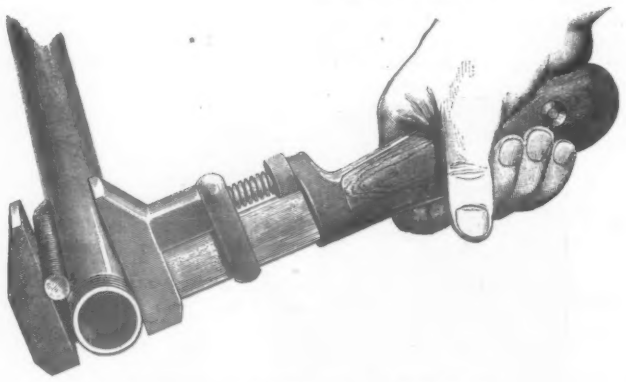
JOSEPH M. WILSON, *President.*
WM. H. WAHL, *Secretary.*

Countersigned by
H. R. HEYL, *Chairman.*

An Ingenious Substitute for Pipe Tongs.

The man who is full of expedients is the one who gets along in the world. If what he wants is not at hand, something else is substituted, and matters progress as though every facility were available.

This applies especially in mechanics, where it is impossible to provide a tool for everything, and when just the tool required —even though there be such a tool—is not at hand.



AN INGENIOUS SUBSTITUTE FOR PIPE TONGS.

An artist for the *Scientific American*, from which the accompanying illustration is taken, recently saw a mechanic who, desiring to unscrew a pipe, and not having pipe tongs or any of the usual appliances for such work, picked up a wrench and a piece of a round file and applied them in the manner shown in the cut. In an instant, and without difficulty, the pipe was loosened.

We have received from the *Electrician* Printing and Publishing Company, Limited, London, "A Pocket Book of Electrical Engineering Formulæ," by W. Geipel and M. Hamilton Kilgour. The work is very complete and is of value to every electrical engineer, including those engaged in metallurgy and chemical manufacturing, as well as those connected with electric lighting and transmission of power.

Sprague-Pratt Electric Elevators.

THE POSTAL TELEGRAPH PLANT IN THE NEW BROADWAY BUILDING—A PERSONAL TRIUMPH FOR MR. FRANK J. SPRAGUE.

As complete, perfect and interesting as are the various electric equipments of the Postal Telegraph building, on Broadway, there is none which is of more interest, whether regarded as a remarkable mechanical and electrical combination, or as a forerunner and prototype of a new industry, than the Sprague-Pratt electric elevator plant.

All other features mark a perfection of detail in industries and practices already well known, but brought to refinement by years of development, and with precedents sufficiently numerous to involve no material risk in their adoption. The electric elevator for high speed duty was, however, an unsolved problem, and one which the combined knowledge and prophesies of the wide-spread hydraulic interests declared to be beyond the possibility of electro-mechanics.

It is hardly necessary to say that, in view of this state of affairs, which much resembled that existing when the Richmond electric railroad was first projected by Mr. Sprague, the decision to depend upon electricity for the service of a building of this character was a very grave one; failure meant a most serious blow to the finances and reputation, not alone of the inventors and engineers, but to everyone concerned in the erection and operation of the building.

It is fortunate that an unusual combination existed which made this venture possible. There was first a broad gauge and confident man who reposed implicit confidence in a building committee composed of men of daring and long experience, ably supported by an architect of exceptional mechanical knowledge and skill. Their decision was made after an investigation of two experimental machines—for they could be hardly considered more than that—which, while showing the vital elements of construction, were of only one-half of the capacity required, and with many things ordinarily determined by time largely undetermined.

The plant as finally developed is also of interest as being practically the result of individual confidence, work and risk, during a time of grave financial depression, and when electrical enterprises were unfortunately under a cloud.

The requirements and guarantees were in brief to duplicate first-class hydraulic service in speed, control, safety and capacity, to improve upon some of its characteristics, and to occupy less space. It was further promised that the cost of operation would not exceed one half that of a corresponding hydraulic plant. In short, the issue was made in the broadest possible manner between the hydraulic and the electric elevator for the highest class of service.

The problem was a hard one. Its solution has taken the most serious effort and represents the result of four years' incessant work, involving a radical departure from existing precedents and the solving of many novel mechanical and electrical problems.

The result is shown in the letter accepting the plant, written after weeks of the severest sort of duty, with open and closed cars on freight and passenger service, carrying loads as high as 3,500 pounds, and under conditions taxing the operation of a machine to the utmost.

It seems to warrant Mr. Sprague's prediction that he would write the epitaph of the hydraulic elevator as that of the horse car had been written at Richmond, and the truth of the statement on the part of one of the building committee that the signing of the Postal Telegraph contract was that epitaph.

So much as a preliminary.

We will now describe in detail as far as may be the features of the plant which is to play so important a part in the future of the elevator industry, first giving a general description of the layouts and then of the particular features of operation.

The elevators are divided into three groups, or pairs, two sets being "way" elevators, stopping at all floors excepting the twelfth and thirteenth and arranged with one general frontage, a gang way in the middle and the main stairs winding around one set. The remaining set constitute the "express" elevators, and stop only at and above the eleventh floor, being practically private elevators for the Postal Telegraph and Commercial Cable offices, operating room and restaurant. This set is placed in the rear of one pair of way elevators and separated from them by the main stairs. All cars have independent platforms fitted with centrifugal governors set to be operated at 600 feet car speed by standing ropes. The car finishes are of ornamental bronze of the usual type. The way cars are a fifth larger than the express and have four hoisting and two counter-weight ropes, while the latter have two less hoisting ropes. The required loads are directly, and the speeds inversely proportional to the floor areas, those for the way cars being 2,400 pounds live load at 325 feet, and for the express cars 2,000 pounds at about 400 feet. The speeds running light are about 10 per cent. higher. These are the present normal speeds, but the motors have been found to be of so abundant capacity that the speeds can be increased to 450 feet for the way and from 575 to 600 feet for the express without difficulty or straining.

The shaft and overhead work is identically the same as in first-class hydraulic plants and variable chain counter-weights are used to make the pull equal at all points of the hoistway for any given car load.

The lower landing is at the street level, with pit extending into the basement. The hoisting ropes lead directly to the outboard sheaves of the hoisting machines in the sub-basement and dividing on either side of the crosshead, pass around the sheaves, 10 geared for the way and 12 geared for the express, and are anchored to the head of the machines.

So far, with the exception of the control, the practice is that of the horizontal hydraulic elevator.

Coming now to the machines in the basement the distinguishing features of the electric plant become pronounced, and first, and by no means the least important, is the space occupied, for here, on account of the peculiar disposition of the cars and the position of the foundations and the party wall, six machines, two at right angles and above the other two, are placed in a space about 30 feet square, with ample room for at least eight more machines, all self contained, each perfectly independent, and with every facility of access and for renewal of any part.

Briefly described, the machine is of the horizontal multiple sheave type with a traveling crosshead and frictionless nut driven by a screw revolved by a motor directly connected and governed by a pilot motor and rheostat.

A reference to the elevation will show the general mechanical construction. This consists of a heavy main beam carrying the traveling crosshead and lower screw bearing, with special castings bolted at each end, one carrying the fixed set of sheaves and the other the thrust bearing, brake and motor. The regulating apparatus is independent and self-contained and is placed on the wall. From the car to the system of multiplying

sheaves this machine and the horizontal hydraulic elevator are practically the same. The crosshead, however, marks the point of departure in the two types, and this is the one at which the troubles of the hydraulic elevator begin, and also the one from which the Sprague-Pratt electric elevator marks its evolution in elevator practice.

In the hydraulic machine this crosshead is rigidly attached to the end of a rod terminating in a piston moving in a cylinder having an inside length equal to the lineal movement of the crosshead. This cylinder in the vertical type of hydraulics varies from 30 to 45 feet in length, with from two to eight sheave multiplications, and in the horizontal types the multiplication runs as high as 12, with corresponding diminution of length of cylinder and increase in cross section. Whatever the gearing, however, the length of cylinder is a function of the car travel. In this electric elevator the crosshead being moved along a screw stationary so far as lineal movement is concerned, there is with any given number of sheaves, only one variable, the length of screw, and for all heights above about 90 feet the electric machine has an advantage in matter of length which with increased rises becomes of great importance.

Turning now to the operation of this machine, there are four features claiming special attention, each unique in character and marking a radical departure from all other elevator practice. These are the nut, screw and bearing, the brake, the motor and the regulating apparatus.

The hoisting nut joins the crosshead of the traveling sheaves by a conical seat. There is no fastening between the nut and the crosshead, the continual weight of the car always keeping them in contact, and the friction at this point being greater than between the nut and the screw enables the latter to transmit a straight line movement to the crosshead when the screw is revolved by the motor, and also to revolve the screw and drive the motor as a dynamo when the mechanical brake releases the screw to allow the car to descend. The only points of contact between the nut and screw are by a chain of balls which occupy 12 threads, and are shown entering and leaving the ends of a nut through a tube which takes the balls as they leave one end and returns them to the other end at a tangent to the line of travel between the threads of nut and screw.

This is one of the most vital points of the elevator apparatus, and herein lies one of the most potent reasons of its success, the reduction of friction by rolling instead of sliding surfaces on almost all parts under pressure, for not only is the nut so constituted, being in fact a spiral thrust bearing, but the thrust bearing at the motor end of the screw is taken on balls and the sheaves are carried on ball or roller bearings.

So free is this machine from static friction that it is possible to start the car with a very slight increase of current over the normal hoisting current, provided time be taken so that the work done in acceleration is small compared to the work of lifting.

A test was recently made on a Fairbank's testing machine in New York to determine the liability of balls crushing under normal or extra working strain, and to settle once for all any doubt as to their ability to stand the duty required of them. Ten balls of two different makes were put under crushing strains, and required from 20,000 to 40,000 pounds to break each of them. Since the working pressure varies from 50 to 125 pounds per ball, there would seem to be margin enough to satisfy the most exacting.

The screw is a specially forged bar of high carbon steel with a peculiar shaped thread. It passes through the clearance hole in the steel trunnion crosshead which carries the traveling sheaves, then through the nut system, and is carried at the outer end by a pivoted bearing. At the inboard end it terminates in the thrust bearing where the pressure is taken by about 220 steel balls carried in a bronze guide plate and bearing on specially hardened steel disks. The thrust of the screw being thus taken up on the inboard end, the strain on the screw is invariably between that end and the traveling crosshead, never beyond this; hence, it is always under extension strain, never under compression. Beyond the thrust plates is keyed a radially lagged iron and wooden pulley connected by a flexible coupling with the motor shaft. The function of the brake is that of locking the screw when at rest, and is not a means of varying the speed. In case of accident it has the additional function of helping to stop the screw.

It may be described as a compound electro mechanical brake. The brake band, of steel and leather lined, is anchored at one end, the hoisting side, on the motor bed frame, and the other end is continually pulled down by a powerful spring under compression. The mechanical movement in

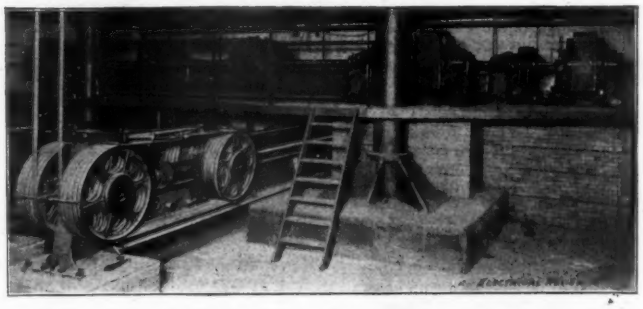


FIG. 1.—THE SPRAGUE-PRATT ELECTRIC ELEVATORS IN THE POSTAL TELEGRAPH BUILDING, NEW YORK—SHOWING GENERAL VIEW OF EXPRESS AND PART OF WAY MACHINES.

opposition is through the medium of a lever fulcrumed on a peculiar magnet casting and having at its short arm end a universal socket connection to the divided core of a closed circuit steel magnet. This core has a movement of one-eighth of an inch, and, with the expenditure of a quarter of a horse-power of electric energy, has a pull of nearly three-quarters of a ton. It is operated by a dual circuit, one in hoisting, another in lowering, each possessing peculiarities in its action. In the event of failure of current, for any reason or too high a speed on the down run, this magnet releases the brake, in the latter case by a snap switch operated by a Pickering centrifugal governor driven by the main screw, and the brake band promptly grips the brake wheel softly, yet powerfully. The operation of the brake on the up and

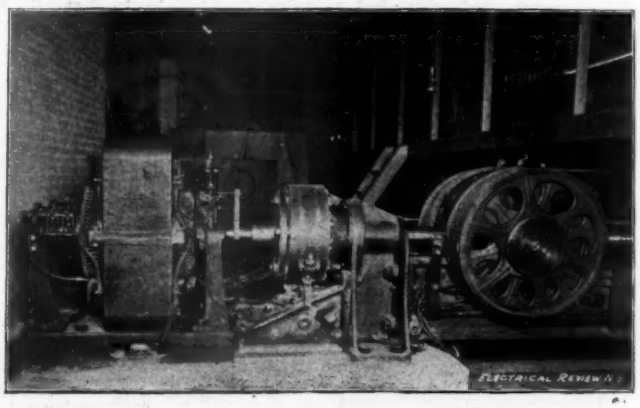


FIG. 2.—THE SPRAGUE-PRATT ELECTRIC ELEVATORS IN THE POSTAL TELEGRAPH BUILDING, NEW YORK—VIEW SHOWING MOTOR, BRAKE, THRUST BEARING AND TRAVELING SHEAVES OF ONE OF THE WAY MACHINES.

down movements is different, and the unexpected softness, yet power of its action, can only be appreciated and understood by an inspection and a further knowledge of a unique electrical action not here described.

The motor is of the four pole type, two poles being consequent, and the winding is strongly compounded. The field magnets are of a special grade of steel. The direction of current in the field coils and armature is never reversed, and the machine is never demagnetized, because, in hoisting the line, electro-motive force predominates, while, in lowering, the reversed electro-motive force of the motor is the only active one in the armature circuit. It should be remembered that this type of elevators is differentiated from all other electrics in that, like the hydraulic, it always works against gravity. The motor takes current from the line in hoisting, but in lowering it is cut off from the line and is operated as a driven dynamo by the falling weight of the car.

The armature is iron-clad, is of the two path special slotted drum construction, has one turn of wire to each coil, and each turn is securely imbedded in an independent insulating tube rigidly held. The carbon brushes are double, have independent movement and ample capacity to carry the full current without flashing. The neutral point is fixed. The machine is self-oiling and the bearings are independent of the field castings.

The last individual feature of the machine to be considered is the regulator and the method of operating it. This apparatus is an independent one and connected to the hoisting machine only by the wires necessary for the circuits. It is in brief an open cast-iron frame carrying inside a slate disk having on the lower side a row of bronze contact slips, and on the other, attached to these clips and to each other by tap screws, a series of grids arranged in a circle. These grids are peculiar and mark an important advance in rheostat construction. They are about nine inches long, four inches wide and three-eighths of an inch thick, and are cast in a form somewhat resembling a ribbon folded on itself. They are freely flexible when taken separately, although iron is one of the principal ingredients. The exact composition is not made public, but whatever it is the resistance averages about 50 times that of copper. The grids can stand a very high current and the temperature co efficient while not constant is sufficiently small as not to be objectionable.

On top of the frame is carried a one-fourth horse-power motor connected to the car switch through a pilot board by a cable of four insulated wires, which operates the rheostat and circuit changers. The motor is coupled to a worm gear which carries a small pinion meshing into a spur gear on the circuit changer and controlling cylinder. This cylinder has a bevel gear driving a pinion on top of a vertical shaft, at the lower end of which is the rheostat brush arm.

This brush arm carries carbon brushes which bear on the bronze clips. There are 120 of these, and the difference of potential between them is too small to allow any sparking. A quick-acting circuit breaker prevents arcing at the first clip. The operator in the car is at liberty to put the brush at any point of its travel and leave it there as long as necessary.

The same rheostat is used in hoisting and lowering and the arm travels over the whole range of clips in either movement. This operation is controlled electrically, either from the car or from the pilot controlling switchboard in the engine room.

In hoisting the operator moves a small lever and the car starts with a perfectly accelerating speed, no jerks or pulsations being felt. Ordinarily he puts the car to full speed and makes his stop exactly at the landing with one motion of the switch.

If, however, he stops a short distance below the landing floor he can raise the car that distance as in a hydraulic elevator. The operator can regulate his speed from slow to full speed, which last may be as high as 600 feet per minute. A small rheostat in the field of the hoisting motor gives a fixed adjustment of about 10 per cent. variation in the maximum speed of the car.

If the operator forgets or is unable to operate his switch to stop the car, there are two automatic stops which will only allow it to go a few feet above the top floor.

We now come to the vitally important element of safeties.

In this connection we will consider the hoisting machine apart from all electric and other safety devices.

First, the screw: This is a bar of special forged steel under tension and torsion strains, and capable of sustaining 20 times the heaviest load applied to it.

Second, the hoisting nut: This is of special steel, hardened and finished by a special process, and has shown almost no wear whatever in a year's severe run under conditions particularly onerous.

In addition to this is a safety nut. This nut is normally out of contact with the screw's thread; it is secured to the hoisting nut, and should any accident happen to latter which would break its hold on the screw's thread, this safety nut, the thread of which interlocks with the screw's thread to a greater depth than the thread of the hoisting nut, would then take the place of the hoisting nut and form an anchorage to hold the traveling sheaves with a grip exceeding the strength of the screw. This would put the elevator out of operation, as the friction between this nut and the screw is greater than the friction caused by the pressure of the traveling sheave crosshead against it; this nut would then act simply as a collar on the screw, and revolving the screw would transmit no motion to the car. It is obvious that the only parts of this elevator that could wear out so as to allow the car to fall if there were no safety nut, are the threads of the hoisting nut or screw. Therefore, having a safety nut which is subject to no wear, and the thread of which reaches nearer the center of the screw than does the thread of the ball nut, a condition of safety is reached which is independent of the wearing out of the machine and also independent of any automatic safety devices. But it may be remarked that special processes of manufacture, amply tested by severe duty, insure an exceedingly low rate of depreciation on the ball nut and screw.

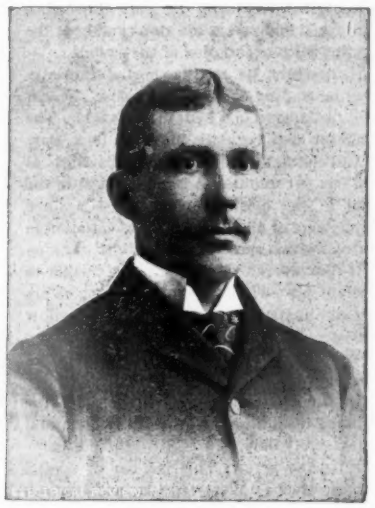
There is another safety in the nut system, however, warranting special mention. As before stated, the hoisting nut is only held from revolving by its friction against the crosshead; when the nut gets to the upper limit of its travel the safety nut meets a solid collar on the screw which stops its travel and causes it and the ball-bearing nut to revolve with the screw, thus stopping the travel of the nut absolutely without stopping the motor, and allowing the traveling sheaves to be stopped simply by the weight of the car. This stop has been made at full speed without any injury whatever. Of course, this never works when the upper limit switch is in proper order, and there is nothing about this last to get out of order.

Hydraulic elevators have been known to knock out their cylinder heads or otherwise wreck themselves when their upper limit valve failed to work.

Another important function performed by the hoisting nut in a very simple and direct way is its action as a slack cable device, and there is no more dangerous annoyance common to all rope elevators than the paying out of slack cable when the car is stopped by some obstruction in its path while

descending. The usual result is either that the obstruction gives way and the car falls to the extent the cables have payed out and perhaps breaks them by the shock, or else the operator starts to hoist the car after the cables have slipped off of the sheaves or winding drum and in so doing cuts and kinks the cables into a useless condition. This is liable to happen to any horizontal hydraulic elevator.

With the ball bearing hoisting nut the result is very different, the action being as follows: The car descending at high speed and driving the nut along the screw, revolving the screw and armature thereby, meets an obstruction, the pressure against the nut



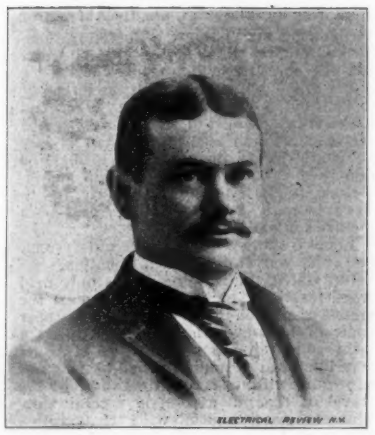
President Wm. H. McKinlock, of the Metropolitan Electric Company, Chicago.

is reduced to only that given by the weight and sag of the ropes, and the working nut recedes slightly, which allows the spiral spring between the safety and ball bearing nuts to extend and force the safety nut against the back of the screw's thread. The friction then between the nuts and the screw is greater than between the safety nut and the crosshead, therefore, the hoisting nut at once revolves with the screw, its travel along the screw ceases, and it checks the travel of the traveling sheaves before the cables are really slack.

This action has been tested with a car stopped by its centrifugals when going at 600 feet per minute.

It is, moreover, evident that if the screw should become free to revolve unchecked by motor or brake, an improbable conception under normal conditions, the weight of the car would not cause the screw to revolve at a speed at all comparable to a free fall. In any event there remains the rubber buffer at the lower end of screw to cushion the end of such a run.

The use of the buffer as well as the frictionless character of the nut have been most



Secretary Walter C. McKinlock, of the Metropolitan Electric Company.

effectively illustrated by actual drops from heights up to the twelfth story. This buffer nut can stop a car going at a speed of 800 feet per minute in 18 inches without starting a bolt or fastening.

In hydraulic elevators there is no speed regulating device in case of running too fast, except the centrifugal on the car, and, usually, this is set so high, on account of the annoyance of having it operated with temporary excess of speed, as to oftentimes be useless when actually required. Another centrifugal is used on this electric machine, which is additional to that on the car, and this is set to operate at a small excess above the allowed speed. It does not interfere with the operation of the car centrifugals, but simply puts the brake on the machine in case of limited excess of speed, and is ready for use again as soon as slowed down instead of being tied up as is the case when a car safety works.

We now come to the all-important question of economy, and here, too, this electric elevator has scored an important victory over the hydraulic, for, while buying current from the street system at the rate of five cents per horse-power hour, reckoned on an 850 watt rate, pending the operation of the local plant, the cars are being operated at a cost not exceeding three-fifths of a cent per round trip of 26 floors, which is not over 40 per cent. of the cost of operating a like hydraulic system, even with an independent plant.

Why this electric elevator is more economical than the hydraulic can be easily seen from the following facts:

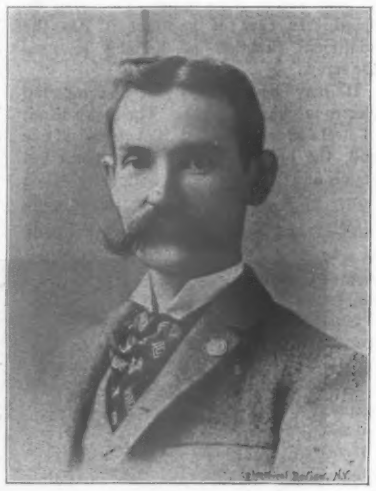
The standard hydraulic elevator, as now operated, is supplied at a practically constant pressure by a compression tank automatically regulated in the basement, or a roof tank, which may be also a compression tank. Whatever the load, identically the same amount of water at the same pressure is used for every foot of travel, and, consequently, no matter how light the car may be running it always uses the maximum power.

Statistics taken time and again prove that the average live load on a passenger car is not over one-fifth the maximum which it can carry.

Including the counter-weight, which in a high speed hydraulic elevator is, on account of the friction, fully 400 pounds lighter than in an electric elevator of equal capacity, on account of the difference of friction, the total average load is about a third of the maximum.

For an example, take a car of 30 feet floor space. This can be loaded up to about 100 pounds per square foot, or 3,000 live load, while the average live load will not be over 600 pounds. In a hydraulic elevator it would take about 900 pounds excess of weight in car over the counter balance to insure proper running. This means a load of 3,900 pounds on the ropes, but this is not all. Since the speed of the car with any given opening of the valve is a function of the difference in pressure in the supply and the cylinder, and since there must be an excess of pressure on the supply side in order to have the car move at all, then to move this total load of 3,900 pounds at even a low speed there must be a capacity to actually lift about 500 pounds more than this, or 4,400 pounds, yet the average load on the ropes is only 1,500 pounds.

In a Sprague-Pratt electric elevator such a car can be operated with 600 pounds excess of weight, making an average load on the hoisting ropes of 1,200 pounds, and since this elevator uses power very nearly in proportion to the load over friction we would have as between the two classes of elevators a constant duty on the hoisting ropes of the hydraulic of 4,400 pounds and on the electric of 1,200. Here then is a difference of



Manager J. J. Nate, of the Metropolitan Electric Company.

nearly four to one in favor of the electric, considering solely the question of work actually done on the hoisting ropes.

Without going into exact statements the friction of the electric machine is quite as low if not lower than that of the hydraulic, because one is on ball bearings, and the other has a tightly packed gland and piston.

Going back now to the generation of power, the best pumps in common use require 70 or 85 pounds of water per horse-power delivered to the water column, whereas electric power can be delivered to the mains of the motor for an expenditure of about 35 pounds of water.

It was well known before this elevator plant was started that the economy indicated would be shown, but it has been some satisfaction to have it demonstrated in so emphatic a manner by a long period of operation.

In view of what has already been accomplished, the future of this system as a controlling factor in the elevator industry will be of interest.

The Metropolitan Electric Company.—Heads of Departments Conferring with the President.—From a Snap-Shot Photograph by the "Electrical Review" Staff Artist.

The Metropolitan Electric Company, of Chicago.

THE REMARKABLE SUCCESS OF THIS ENTERPRISING ELECTRICAL HOUSE—INTERESTING VIEWS OF THE OFFICES AND OFFICIALS.

Since about the first of the year the Metropolitan Electric Company have occupied the spacious and elegant store at 186 and 188 Fifth avenue, Chicago, in the heart of the wholesale business district of the city.

Although this company was organized during the worst business depression known for years, it rapidly outgrew its initial quarters and its increasing trade demanded larger and better accommodations, both for covering its stock and for the quick shipment of orders.

The growth of the company is due entirely to the experience and broad business policy of its president, Mr. William H. McKinlock; the energy and assiduity of its secretary, Mr. Walter C. McKinlock; and the executive ability of its general manager, Mr. John J. Nate, all of whom are more than ordinarily well-known and popular in the electrical business. The company has a large local retail trade which is profitably and successfully handled, chiefly owing to the geniality and accessibility of its officers.

The front of the store is almost entirely of glass and the premises are especially favored with natural light. No electrical house in the country is better located in this respect, and this imposing front, with neat and tasteful lettering, has attracted favorable comment from all. The ground floor is 50x100 feet and is occupied by the general offices, the president's private office, the cashier's department, the sales department and the shipping room. The basement extends under the sidewalk, is 50x110 feet in size and is used as a store-room. With these facilities for carrying a large stock and ample shipping arrangements the Metropolitan Electric Company is in a position to fill orders in the prompest possible manner.

Mr. McKinlock is a believer in electrical specialties, but only those of a high order of merit find a place in the Metropolitan company's stock-room. The company is general western agent for the famous N. I. R. insulated wires and cables, made by the National India Rubber Company. The line

of these goods carried in stock includes electrolier wire, twin-wire, concentric wire, lamp cord, rubber tape and rubber tubing. A large business is done in Paiste switches, cut-outs, bushings and clutches. The Standard Paint Company's well-known P. & B. compounds are most ably handled by the Metropolitan company as western agent. The "Mac" tape, possessed of superior insulating properties and valuable for armature and field magnet covering, the Metropolitan incandescent lamp and the Metropolitan transformer are a few of the many other specialties carried in stock.

THE METROPOLITAN ELECTRIC COMPANY—VIEW IN A CORNER OF THE COMMODIOUS STOCK ROOM.

A New Atlantic Cable.

When the steamer "Faraday," which sailed from London on April 11, shall have completed her work, the king of submarine cables will lie along the bed of the Atlantic, between the coast of Ireland and Canso, Nova Scotia.

The cable is the third and largest of the Commercial Cable Company's lines. George G. Ward, the vice-president and general manager of the company, said last week that the new cable will probably be ready for work on July 1. It will greatly increase the company's already splendid facilities for communication with Europe.

The ordinary speed of transmission is about 18 words a minute. It is expected that the improvements adopted will raise the speed to 30 words a minute over the new cable.

The expected increase in speed is wonderful. In cabling everything is sacrificed to speed and accuracy, and the new cable promises an unparalleled standard in both these respects.

The material for the new cable is being manufactured by Siemens & Brothers, of London, at a rate of 200 miles a week. The steamer "Faraday," when she left London, on April 11, carried 500 miles of the insulated wire. She will lay 100 miles of this outward from Ballinskellig's Bay, on the Irish coast. Then she will cross the ocean to Fox Bay, Canso, Nova Scotia, and place 400 miles there. The latter section will be buoyed up in shallow water.

The "Faraday" will return to London then for the remaining 1,500 miles of material and reel it out on her second run to the westward. She will begin her second voyage on June 1, and it is expected that the ends will be joined and the cable given the power of speech by June 15, if the weather be favorable.

The duplex apparatus, which will double the cable's carrying capacity, is now being manufactured, and the new line will probably be ready for business on July 1, or soon after that date.

Electricity for Frost-Bite.

Although the past Winter has in most places been of exceptional mildness, it has developed a new cure for frost-bite. It is reported that Dr. Helbing has been successful in Germany in 20 cases in healing people of frozen nose. The treatment consisted in applying electrodes to the opposite sides of the nose, and passing a moderately strong current for five or 10 minutes, moving the electrodes about. The immediate result is a reddening of the tissues, which may last several days, after which the skin and the flesh resume their normal condition. In extreme cases from 10 to 15 applications have been found necessary.

TELEPHONE NEWS AND COMMENT.

The Bell Company is very sure of the privilege requested of the Massachusetts Legislature to increase its capital from $20,000,000 to $50,000,000. The Committee on Mercantile Affairs has reported favorably.

A circular has been issued by the Wisconsin Telephone Company stating that in the future a charge of two cents for every call after the 1,000 limit has been reached will be charged. The year will be divided into quarters, and at the end of each quarter the subscriber who has originated more than 250 calls will receive a statement of the additional calls, which will be charged against him.

The New Jersey Postal Telegraph and Telephone Company has been organized, and will presumably be operated in connection with the plant of the Postal Telegraph Company. The company is said to be getting ready for active service, and in this territory will have a good deal to get ready.

An active worker against the telephone company's rates in a large city of this State is singing very low since he appeared before the Assembly Committee at Albany. It was discovered that he was not only not a subscriber, but was stealing his service from an adjoining drug store and advertising that telephone as his own. The reformer was politely but promptly informed by the chairman of the committee, when this fact was brought to his attention, that the committee could not give attention to complaints from such a questionable source—that it would be well for the would-be reformer to extract the beam from his own business methods before tackling the mote in the rates of the company.

THE METROPOLITAN ELECTRIC COMPANY—VIEW SHOWING PART OF THE GENERAL OFFICES.

Mr. Hoeftmann Doesn't Think it is a New Wire.

TO THE EDITOR OF ELECTRICAL REVIEW:

Referring to an article which appears in your issue of April 4, 1894, termed "A New Wire," I should like to say that the class of insulated wire which you describe has been manufactured in this country ever since 1885. Grimshaw, Habirshaw, the Indiana Rubber Company and Washburn & Moen Manufacturing Company and several others, are the names of firms who have made a specialty of wire answering exactly the description which you print. The inner layer of rubber free from sulphur was invented and patented by Mr. Warren in 1874 when at Hooper's Telegraph Works, London, England, and was termed the "separator," because it prevented the sulphur contained in the outer insulation from attacking the tinned wire, preventing corrosion and destroying the conductor. I myself made this class of wire in England as long ago as 1880, and have manufactured it with the above mentioned firms since 1885. By publishing this in your next issue you will oblige,

Yours respectfully,
O. HOEFTMANN,
Washburn & Moen Manufacturing Co.,
April 11, 1894. Worcester, Mass.

ELECTRICAL REVIEW

Published at 13 Park Row,
P. O. Box 2339. NEW YORK.

EDITOR:
CHARLES W. PRICE.

ASSOCIATE EDITOR:
STEPHEN L. COLES.

REGISTERED CABLE ADDRESS:
"ELECTVIEW," NEW YORK.

1546 "CORTLANDT," TELEPHONE CALL.

BOSTON OFFICE:
H. G. TUCKERMAN, Room 29, 620 Atlantic Ave.
CHICAGO OFFICE:
FRED. De LAND, 436 "The Rookery."
WASHINGTON OFFICE:
GEO. C. MAYNARD, 800 H St., N. W.

ADVERTISING DEPARTMENT,
H. T. RICHARDS, Manager.

SUBSCRIPTION TO THE
ELECTRICAL REVIEW.

One Year, United States and Canada, - $3.00
One Year, Foreign Countries, - - 5.00
Single Copy, - - - - - - - .10

NEW YORK, APRIL 18, 1894.

CONTENTS.

	PAGE
Views, News and Interviews	185
National Telephone Apparatus	188
Electric Lighted Buoys for Mobile Bay	183
The Edson Pressure Recording Gauge Receives the John Scott Legacy Medal and Premium	184
An Ingenious Substitute for Pipe Tongs	184
Sprague-Pratt Electric Elevators	184
The Metropolitan Electric Company, of Chicago	186
A New Atlantic Cable	187
Electricity for Frost-Bite	187
Telephone News and Comment	187
Mr. Hoeftmann Doesn't Think it is a New Wire	187
Electricity and Fires in Boston	188
Correspondence:	
Our Chicago Letter	189
Our Boston Letter	189
Wall Street News and Electrical Stock Market	189
General Manager of the Royal Arc	189
Personal	189
The Ball & Wood Company's New Type of Vertical Compound Engine	190
Electric Light Flashes	190
Affairs of the General Electric Company	191
Electric Railway Notes	191
Electric Lighting	192
Young Men's Institute	192
The General Electric Company at the Midwinter Fair, San Francisco	193
Measurement of the Capacity of Condensers with Alternating Currents	193
American Metrological Society	193
Telephony Without a Wire	193
The Chicago Rail Bond	193
Kindred Interests	194
Electrical Patents	x
Advance Information	x
Another Big Street Railway Deal	x
Suit Against New York City	x

INDEX OF ADVERTISERS.

COVER PAGES.

	PAGE
Abendroth & Root Mfg. Co.	xvi
American Electrical Works, insulated wire	i
Ansonia Brass & Copper Co., wire	xvi
Armington & Sims, engines	xvi
Beacon Vacuum Pump and Electrical Co.	i
Bunnell & Co., J. H.	i
Campbell Electrical Supply Co., insulating tape	i
Day's Kerite, insulated wire	i
Eastern Electric Cable Co., insulated wire	xvi
Eddy Electric Mfg. Co., motors	i
Globe Iron Roofing and Corrugating Co.	i
Goubert Manufacturing Co., Stratton separators	xvi
Hampson & Co., E. P., engines	xvi
Holtzer-Cabot Electric Co	xvi
McKenney & Waterbury	i
Metropolitan Electric Co., general electrical supplies	ii
National India Rubber Co.	i
Okonite Co., insulated wire	i, xvi
Rhode Island Tool Co., drop forgings and tools	xvi
Royal Arc Electric Co	i
Stirling Co., boilers	xvi
Underwood Co	i
Weston Engine Co., engines	i

INSIDE PAGES.

	PAGE
American Bell Telephone Co.	iv
American Carbon Co., carbons	viii
Anthony, William A., electrical engineer and expert	194
Baker & Co., platinum	194
Berlin Iron Bridge Co., iron roofs and buildings	xiv
Bishop Gutta Percha Co., insulated wire	xiii
Brixey, W. R., wire and cables	viii
Brush Electric Co	vi
Bryant Electric Co	v
Buckeye Electric Co., incandescent lamps	viii
Buckeye Engine Co., engines	iii
Butler Hard Rubber Co., battery cells	xi
Case Engine Co., The J. T., steam engines	viii
Central Electric Co.	iii
Clark Electric Co., arc lighting	iv
Clonbrock Steam Boiler Works	v
Correspondence School of Electricity	194
Correspondence School of Mechanics	194
Day-Moberg Electric Co	xiii
Diehl & Co.	iii
Dixon, Jos., Crucible Co., belt dressing	vii
Edson, Jarvis B., recording and alarm gauge	xi
Electric Construction and Supply Co.	iii
Electrical and Mechanical Engineering and Trading Co.	194
Electric Storage Battery Co., accumulators	xiii
Empire China Works, porcelain specialties	iv
Equitable Life Assurance Society	xi
Falls Rivet & Machine Co., friction clutches	xiii
Faraday Carbon Co., carbons	vii
Fidelity Carbon Manufacturing Co., carbons	iv
Garvin Machine Co.	xi
General Electric Co.	ix
General Electric Launch Co., electric launches	194
Gooch, Chas. J., patents	x
Greeley & Co., The E. S.	xiv
Harrisburg Foundry & Machine Works, engines	vi
Harrison International Telephone Co.	iv
Hathaway Office Building	xi
Helios Electric Co., arc lamps	vi
Hill Electric Co., W. S.	iii
Hornberger Mfg. Co.	v
Hulbert Fence and Wire Co.	iv
Johns Mfg. Co., H. W., vulcabeston	iii
Leffel & Co., James, water wheels	xiv
Lehigh Valley Creosoting Co., creosoted lumber	194
Leonard & Co., H. Ward	194
Marshall, Wm., condensers	iv
Moore, Alfred F., wire	vii
Morris, Tasker & Co.	v
National Pipe Bending Co., feed-water heater	ix
New England Engineering Co.	viii
New York Belting and Packing Co., rubber belts	iv
New York Insulated Wire Co., wires and cables	xiii
New York & New England R. R.	194
New York & Ohio Co., incandescent lamps	v
Ostrander & Co., W. R., supplies	vi
Pettingell-Andrews Co.	xiv
Phoenix Glass Co., globes	v
Photo-Engraving Co., engravings	iv
Pope, Read & Rogers	194
Queen & Co., electrical instruments	v
Ridlon & Co., Frank, general machinery	vi
Robinson & Orr, steel rails	vi
Rosenthal, Dr. R. S., Correspondence School	x
Royce & Marean, electrical supplies	vi
Schieren, Chas. A. & Co.	194
Splitdorf, C. F.	vi
Standard Paint Co.	viii
Western Electric Co., supplies	iv
Western Telephone Construction Co.	iv
Westinghouse Electric & Manufacturing Co.	vii
Weston Electrical Instrument Co., measuring instruments	viii
White Dental Mfg. Co., acid gravity battery	vi
Wilson, Fremont, electrician	194
Wyckoff Pipe Co., inc.	viii

A 40-mile, single rail, storage battery, elevated railway is to be built between Lake Ontario and Batavia, N. Y. All of us will be interested to hear of its success.

All honor to the progressive and enterprising manufacturing electrical companies and allied companies who keep fully abreast of these electrical times! The ELECTRICAL REVIEW presents several interesting accounts of their work in this issue.

For broad definitions of electrical terms see the New York *Mercury and Daily America*. Here's a sample:

"Electrolysis is the name for the disintegration and destruction of gas and water pipes caused by the electricity which escapes from trolley wires into the surrounding earth."

The press dispatches from Chicago last week said that Postmaster Hesing intended to talk with Washington and thus inaugurate the "Long Distance Telephone Mail Service." This sounds big and struck the reporter's fancy evidently. We presume the mail will be done up in minute elongated packages and be sent through the hole in the wire that the electric current passes through!

Better electrical times are at hand.

We wonder if the manufacture of lightning rods is what it used to be?

The Advanced Scientists are soon to meet in Brooklyn. Among their number are many electrical men.

The "Advance Information" department of the ELECTRICAL REVIEW tells its own story of increasing electrical development.

The epidemic for new telephone companies seems to be more prevalent in the South. Illinois is also an eager State in this respect.

The reign of Mr. M. J. Francisco as president of the National Electric Light Association will undoubtedly be a practical and progressive one.

There is not a city in the United States as well lighted as it should be. City fathers should be made to see this. Educate, educate, ye apostles of electric light!

If Lieut. Frank J. Sprague outdoes the hydraulic advocates with his electric elevator he will have added another laurel to his brow. It looks as if he had accomplished it.

The announcement of a new conduit electric railway system by one of the leading companies may be expected within 60 days. Every test so far is reported to have been satisfactory.

Burial of electric wires grows apace. It would seem that the stately pole and its widespreading cross-arms on which are so often seen perched the well-caparisoned lineman will soon disappear from our cities.

Inventors of electric carriages will have a hard time to make their inventions a commercial success in London. A correspondent of the *Times* points out that under the present regulations an electrically propelled parcels van is a locomotive, within the meaning of the Locomotives Acts, and is subject to the provisions of these Acts as regards not going at a greater speed than two miles an hour, having a man 20 yards in front, and having three men to drive.

Mr. Joel C. Clark sends us a check for subscription to the ELECTRICAL REVIEW, and encouragingly concludes by wishing us "success in the publication of the ablest of all electrical papers." These and similar kindly words, so numerous of late, make the brainy, able and industrious toilers around this office more than ever contented with their lot. And then—more contentment!—so many of them, as did Mr. Clark, remember to enclose the subscription check.

An interesting point in law was developed in New York city last week. A club rented a house and secured a reduction in the rental in consideration of making some improvements, among which was the introduction of electric fixtures and wiring. The lease of the premises expired, and the club deciding to move proceeded to take away the electric fixtures. The landlord protested without avail, and finally secured an injunction from Judge Bookstaver restraining the club from removing the fixtures.

ELECTRICITY AND FIRES IN BOSTON.

Mr. Harry C. Cushing, electrical inspector for the Boston Board of Fire Underwriters, has been engaged for some months past in investigating some of the causes of fires, which are generally classed as "unknown." The results of some of his researches are interesting from an electrical standpoint, and while Mr. Cushing does not agree with those who are prone to attribute all fires of this class to electric wires, he still finds much to condemn in the careless manner in which the current is allowed to escape, especially in street railway work. According to statistics, there were in Boston during the year 1893, 1,233 fires, causing an aggregate loss of $5,024,765, of which 20 per cent. were attributed to "unknown causes." In looking carefully into the elements which might figure as bearing upon the case in hand, Mr. Cushing finds the greatest source of danger, in his opinion, in the heavily charged gas and water pipes entering buildings, which act as conductors for the electricity making its way back to the power houses through the ground. The old question of electrolysis is the main source of trouble, and though the West End company have been making strenuous efforts to overcome this difficulty by carrying the return current through large copper cables, many samples of gas and water pipes have been unearthed which have been completely eaten through by electrolytic action within three months from the time they were placed underground. In the course of his investigation, Mr. Cushing claims to have found in the basements and cellars of many houses, a large difference in electrical pressure between two pipes entering within a foot of each other, and in one instance it was a very easy matter to take a piece of hoop iron and draw an arc sufficient to ignite a piece of waste held near it. By connecting these two pipes by a piece of No. 18 copper wire, the current flowing through it was sufficient to heat it so that it was impossible to handle. In the basement of another building within the city limits he found a man obtaining enough current to run small motors and incandescent lamps as well as all the electric bells, by simply twisting wires around two different water-pipes which entered the building. Another instance was where two pipes were found so close together that the vibration of an elevator engine caused them to knock together just sufficient to create an arc every time the contact was made and broken. This had been going on so long that it had almost eaten through the gas pipe, and the result can be imagined if it had been allowed to continue until the gas became ignited. Mr. Cushing attributes many of our fires to these causes, and states that in his opinion the only way to eliminate the danger would be for the street railway companies to insulate from the ground their entire circuit.

The Jacksonville, Fla., *Times-Union* seems to have forgotten its true Southern chivalry when it makes these remarks:

The street car companies are laws unto themselves. If you enter a car when the seats are all taken you do so at your own risk. If you dislike to stand you are at perfect liberty to get off and wait for another car. There is no law compelling you to inconvenience yourself. If you enter a car and finding plenty of seats take one for yourself, you are entitled to occupy that seat until you arrive at your journey's end. There is no law, either specific or implied, to compel you to give up the seat for which you have paid to some one who has not paid and who has no claim on it whatever. Why should you give up your seat, even to a woman? The matter of sex cannot vitiate the right for which you have paid all that was asked.

CORRESPONDENCE.

OUR CHICAGO LETTER.

Mr. R. H. Pierce returns to Chicago this week from an extended trip along the Pacific coast.

The Freeport, Ill., electric street railway has been purchased by a syndicate headed by R. S. Brown, of Easton, Pa.

Mr. A. S. Hibbard, general manager of the Chicago Telephone Company, has been called East on consultation and will probably be absent 10 days.

Mr. G. A. Beach, a brother of Franklin G. Beach, of the Central Union Telephone Company, is suffering from the loss of a leg cut off in a railway accident.

Mr. O. N. Caldwell, 127 West Washington street, will send an interesting circular on the economical operation of gas and gasoline engines to anyone interested in this subject.

Mr. William D. Pickels, resident manager of Warren Webster & Company, has opened handsome offices in the Monadnock building, finding the location more convenient than the former office on Canal street.

Mr. R. J. Randolph, general Western manager of the Excelsior Electric Company, has just returned from a trip to New York with the committee from the city council of Detroit, who went East to inspect the Excelsior apparatus.

The Sunbeam Lamp Manufacturing Company is now permanently located in handsome offices at 100 Washington street, Chicago. It is gratifying to learn that orders for Sunbeam lamps continue to increase as time goes on, and that a customer once gained is seldom lost.

Pierce & Richardson, 527 Manhattan building, Chicago, have secured the agency of the Chloride accumulator and are already booking orders. Mr. Charles Blizard, the general sales agent of the Electric Storage Battery Company, who placed this agency, has returned to Philadelphia.

William Baragwanath & Son, 50 West Division street, Chicago, builders of the well-known steam jacket feed water heater and purifier, have several hundred heaters ready for shipment. These heaters range in capacity from 15 horse-power to 300 horse-power, and were built during the past six months, principally to prevent their skilled employés from being forced into the army of the unemployed.

James I. Ayer & Company, 622 Security building, St. Louis, are erecting a new lighting plant in the Mercantile Club, one in J. L. Hudson's new clothing house, are overhauling the plant of the Pastime Athletic Club, reconstructing the plant of the Citizens' Electric Light and Power Company, East St. Louis, and preparing a report for a railway and a lighting company, which indicates a desirable activity in their business.

The C. C. Warren Electric Company, Manhattan building, Chicago, are about to place an engine dynamo on the market. Like other forms of inductor alternators, there are no moving conductors. The field magnet is the toothed rim of the fly-wheel, these teeth or poles revolving past the ends of the armature coils. The first machines will shortly be placed in service and their efficiency and suitability will be closely watched by several persons who appreciate the good selling points of this apparatus, and will endeavor to secure agencies should it prove all that is claimed for it.

North Shore Electric's mortgage bonds.—A deed of trust on first mortgage gold bonds for $650,000 to the Illinois Trust and Savings Bank has been filed by the Chicago North Shore Street Railway Company. The deed is under date of March 15, and is for 18 years, expiring April 1, 1912. It covers bonds already issued to the amount of $650,000 and future issues to aggregate not over $1,500,000. The mortgage covers all property, including real estate, rolling stock, tracks, stocks, etc., now owned or that may in future be acquired by the railway company.

Chicago, April 14. F. De L.

OUR BOSTON LETTER.

A Survey has just been made in the interest of the Manchester Street Railway Company of a proposed extension of their line from Manchester, N. H., to Lake Massabesic. The road will probably be completed this Spring.

The Howard Bullough American Company have purchased a large tract of land in the town of Attleboro, Mass., and will erect an $80,000 plant there for the manufacture of mill machinery. This company, which represents a capital of $600,000, will prove a valuable addition to the manufacturing interests of New England.

The Controversy between the management of the Lynn & Boston Street Railway Company and the local union of the Federation of Labor is likely to be brought to an amicable settlement at an early date. After a conference lasting five hours a modified agreement was reached a few days ago, which will be submitted to the union for approval, and as other labor organizations are ready to work under the proposition offered, it is expected the matter will be definitely settled.

The Fourth Anniversary of the Massachusetts Electrical Engineers and Mechanics Association was commemorated by a banquet at the American House, on Wednesday evening the 11th instant. President Joseph L. Winn presided, and among the special guests were: W. E. Atkins, Chas. Edgar, Calvin C. Stevens, Wm. Hancock, F. A. Kimball, G. A. Gates and a number of other well-known personages. A very pleasant evening was spent in listening to music and recitations and discussions on matters of general electrical interest.

Mr. William Lee Church, of the firm of Westinghouse, Church, Kerr & Company, of this city, left town on the 11th instant, for a trip to Nassau, where he will spend a month. Mr. Church is just recovering from a very severe attack of the grip, brought on by exposure and overwork during the past Winter, and which has made very serious inroads on his usually robust constitution. It is hoped the genial climate of Nassau will contribute to his speedy recovery. Mr. Henry J. Conant will have charge of the company during Mr. Church's absence.

The Legislative Committee on mercantile affairs has practically decided to submit a bill providing for the placing of wires underground in the streets of Boston. The details of the plan are as yet undecided and will, no doubt, prove a matter of much further discussion, as the interests at stake are deemed to be among the most important matters upon which the present legislature is called to render judgment, as the committee is adverse to submitting a bill that may be greatly modified and altered in the debate to which it will certainly be submitted. The matter of the municipal ownership of wires will, in all probability, meet with an unfavorable report, from the fact that this matter of burying wires is as yet, practically, in an experimental stage, and it would be unwise to burden the municipalities with the construction of conduits which might hereafter be found entirely unfitted for the uses for which they were intended, and which would eventually be discarded, as further knowledge on the subject demonstrated the requirements of an underground system. It would also appear that, if the companies themselves had the work in hand, they would be more liable to use every precaution against future loss, from the necessity of doing their work over again, than would be the case under municipal construction, where the city would expect to receive a rental for their conduits, no matter how imperfect the construction, as, in this case, the companies would be obliged to use them or abandon the field entirely. Another view of the matter is that, if the legislature can now authorize municipalities to purchase conduits already constructed, it would have authority to take the same action later on if, at any time, it be found that the system has been sufficiently developed to justify public ownership. H. G. T.

Boston, April 14.

Wall Street News and Electrical Stock Market.

The market for stocks was somewhat narrower this week than last. Operations were more of the professional order, the bears were more assertive, and on different days of the week attempted to break prices. Their efforts were without success. As soon as the pressure were removed prices rebounded, and at each time crystallized on a slightly higher basis. The news of the week has been bad and the remarkable resistance which the market has made in the face of these pessimistic conditions, shows that the advance which started in about a month ago possesses an undercurrent of strength that is going to carry it forward slowly and steadily, and ultimately establish prices on a much higher and staple basis.

The feature in the electrical world was the annual meeting of the General Electric Company, which was held in Schenectady on Tuesday. The developments at this meeting demonstrated what I have heretofore said in this column, viz., that the policy of the present management is to meet the new condition of affairs, which was forced by the panic, fairly and squarely, and in the interest of shareholders. At this meeting the action of the board of directors at its various meetings during the year, was approved. The old board was re-elected and shareholders authorized the increase in the number of directors from 11 to 13. The two vacancies are to be filled by the board of directors. A stockholder raised the question as to what action the company proposed to take to rectify the $12,000,000 impairment in capital as set forth in the annual report. President Coffin replied that no action had been taken nor had been contemplated. On motion of C. H. Coster, of Drexel, Morgan & Company, the directors were authorized to call a special meeting of the stockholders to remedy the matter in accordance with law. This means that the capital stock is to be reduced.

The directors have not yet held their meeting for the election. I am told that there will be no changes in the board with the exception of the election of Mr. Westover as secretary in place of Mr. Garfield, resigned. A list of stockholders submitted at the meeting contained between two and three thousand names, showing that the stock is well distributed. It is understood that large holding have not been decreased in the year.

Those interests which are bullish on General Electric stock had their position strengthened by the reports of those who attended the annual meeting and inspected the company's works. There has been a popular supposition for some time that business in electrical manufacture was at a standstill. This inspection showed that there was considerable activity at the works and that business is increasing steadily.

Boston is very bullish on General Electric. Reports from that city say that it has on hand $90,000 more cash than its bills payable and its endorsements are only $700,000. Manufacturing concerns generally have suffered as General Electric has suffered, but none of them have marked down their assets as radically as General Electric.

The stock has been very quiet, ranging between 40 and 41, closing at 40¾ without feature. The bonds were not traded in on the New York Stock Exchange. The preferred stock was steady at 68 to 69.

Westinghouse scored a material advance during the week, the preferred advancing to 51 bid and 52 asked, and the assenting certificates to 35⅝ bid and 36 asked. This advance was on Wednesday, the one day in the week on which General Electric showed some weakness. It is said to have been due to some changing of General Electric stock into Westinghouse stock.

It is said that Westinghouse has increased its force on account of large orders for railway apparatus. Part of its works have been running double time on the Niagara Falls Power equipment. The company has closed contracts with the Consolidated Railway Company of New Jersey for the equipment of 1894, variously estimated to be between 300 and 500 cars.

Western Union lost about a point during the week up to Friday, closing at 84⅞. There was one sale of the collateral 5 per cent. bonds at 106½.

Edison Electric, of New York, held its advance of last week, selling between 103½ and 104. The 5 per cent. bonds were quite active and strong between 107¼ and 107¾. The company declared a quarterly dividend of 1½ per cent., payable May 1. Books close April 21 and reopen May 1. Following is given the last published statements of this company:

	1894.	1893.	Changes.	
Gross earnings.....	$112,605	$102,956	Inc.	$9,649
Op. expenses and taxes.....	52,408	59,362	Dec.	6,954
Net earnings.....	60,196	43,593	Inc.	16,603
From January 1 to March 31:				
Gross earnings.....	$371,847	$328,965	Inc.	$42,882
Net earning.....	210,025	164,777	Inc.	45,248
Interest on bonds...	45,566	40,291	Inc.	5,274

American Telegraph and Cable sold from 88 to 89. Commercial Cable was bid 130. The asking price is much above that figure. The company has commenced April 12 to lay its new cable across the Atlantic. It will be larger than the other cables, have a capacity of 30 words per minute against the maximum capacity of 18 words per minute now obtained, and will be completed June 15.

On the Boston exchange Bell Telephone was steady without material change in quotations at 189. Erie Telephone advanced from 43⅝ to 46½ New England Telephone from 53 to 55, reacting to 53. Fort Wayne Electric dropped one point, owing to the valuation based upon the General Electric holdings of that stock as set forth in its annual report of $1 per share. It was bid 2 and held at 3. BAIN.

New York, April 14.

General Manager of the Royal Arc.

JAMES I. AYER, OF ST. LOUIS, FORMER PRESIDENT OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION, WILL BECOME A NEW YORKER.

The ELECTRICAL REVIEW is pleased to learn that Mr. James I. Ayer, of St. Louis, has been appointed general manager of the Royal Arc Electric Company, of New York city, and will make this city his home. Mr. Ayer is widely known as the general manager of the Municipal Lighting and Power Company, of St. Louis, and more recently as the head of the engineering firm of James I. Ayer & Company, of that city.

The Royal Company is extremely fortunate in securing Mr. Ayer's services, as his engineering ability and experience in electrical matters will be of great value in his new position. Mr. Ayer's connection with the already strong *personnel* of the Royal company will make it a powerful factor in the electrical business.

PERSONAL.

Hon. H. L. Storke, postmaster of Auburn, N. Y., and a well known telephone man, was a New York visitor last week. Mr. Storke has been quite ill for several weeks with la grippe, but is now fully restored to health.

Two men of striking appearance and both original and progressive in their lines were seen going into Delmonico's together the other evening. They were Professor Nikola Tesla, the eminent Hungarian electrician, and Frank W. Hawley, who first applied electricity to the propulsion of canal boats and successfully organized the great syndicate for the distribution of electricity generated at Niagara through the State. Mr. Tesla gave Mr. Hawley a banquet and the guests paid homage to the latter, one of the speakers saying he was one of the most successful organizers New York had ever produced, and that he had an unlimited command of capital to carry out the great undertaking. As vice-president of the Cataract General Electric Company he is making a stir. Evidently Mr. Tesla is interested in the enterprise. — *New York Commercial Advertiser.*

The Ball & Wood Company's New Type of Vertical Compound Engine.

The illustrations herewith show a new type of vertical compound engine recently completed by the Ball & Wood company, at their Elizabethport, N. J., works for the Chicago Edison company. This engine is of 600 horse-power, non condensing, with cylinders 19x31x24 inches, using steam at 125 pounds initial pressure and running at 150 revolutions per minute.

Engineers and the public at the present time seem divided in their preferences between two types of engines—the slow speed, represented in its best form by the Corliss engine, and the high speed, in the various forms which have recently come so largely into use. The Corliss engine has been, and is now, the standard for economical consumption of steam, but the high speed engine offers so many other advantages that, in many cases, it becomes unquestionably the better one for practical service.

Since the beginning of this rivalry between the two classes of engines, there has been a recognized p ace for an engine which possesses the best economy of the Corliss engine, and at the same time some of the undisputed advantages of the high speed type, in the direction of higher rotation, smaller floor space and better regulation.

The recent advent of electrical dynamos, arranged to be placed directly on the engine shaft, has greatly emphasized the want above described, because of the great saving in cost of dynamos when higher rotative speeds are employed, and the desirability also of close regulation.

With increased rotative speed shorter stroke is permissible, and hence the vertical form of engine, with its many advantages, offers fewer disadvantages than when extremely long strokes are used.

The engine herewith described has been designed and built with the foregoing state of facts in view, and, it is believed, will meet the hearty approval of engineers. The chief characteristics claimed for it are:

First. Unexcelled economy, obtained by minimum clearance spaces, and correct distribution of steam. Second. Moderately high rotative speed. Third. Superb regulation. Fourth. A cut-off valve gear giving rapid cut-off and wide opening of ports at all points from zero to three-quarter stroke. Fifth. Small floor space. Sixth. Special adaptation to driving direct-connected dynamos, by reason of the shaft being entirely unencumbered with valve gear at both ends outside of the pillow blocks. Seventh. Desirability for mill work, in the combination of economy and regulation.

The expression "unexcelled economy of steam" is often applied indiscriminately, and even to the most wasteful engines. Purchasers have learned to interpret this expression according to the probable performance of the engine as judged by well-known principles of steam engineering, established by careful tests. For instance, correct steam distribution and small clearance are features that are found in every engine that has made a record for small consumption of steam. The best steam distribution is undoubtedly obtained with some form or modification of the Corliss wrist plate motion and valves, and the smallest possible clearance is obtained by placing these valves in the cylinder heads. The engine holding the world's record for economy at this writing has just this arrangement. For good reason then it has been adopted in the engine under consideration.

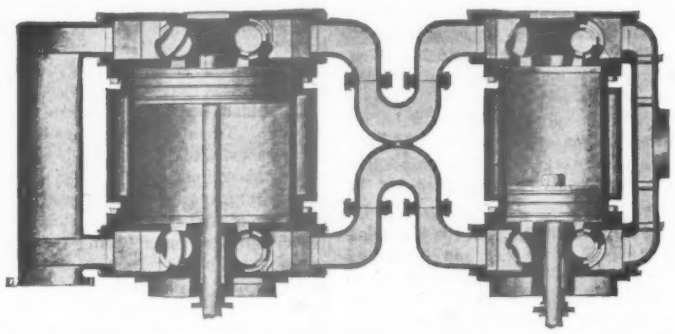


FIG. 2.—SECTIONAL VIEW OF CYLINDERS AND VALVES OF THE BALL & WOOD COMPANY'S NEW VERTICAL ENGINE.

The Corliss releasing gear practically limits the rotative speed to about 100 revolutions per minute, or less, but in the engine here described the automatic cut-off is obtained by independently operated cut-off valves placed inside the steam valves, and actuated by a specially designed governor. This arrangement places no restriction on rotative speed, which is decided by other considerations, and the aim has been to find a medium unobjectionable to the slow speed advocates.

The governing mechanism of the engine must be of special interest to the student of valve gears. Beginning with a well-known form of shaft governor, the principles of which have attracted the attention and admiration of the ablest engineers of the day, the superb regulation thus obtained is made effective by transmitting the necessary motion to the cut-off valves through a special wrist plate device, in which a compound motion is obtained, and the cut-off valves at all points of cut-off operate relatively to the main valves just as though the latter were standing still, thus preventing wire drawing of steam at any point of cut-off.

The location of the valves in the cylinder head, giving as it does the shortest possible ports, permits of their being of ample capacity without an appreciable increase of clearance.

The peculiar motion of the cut-off valve utilizes these wide ports to the fullest possible extent, and the cut-off motion at every point from zero to three-quarter stroke is a rapid one, in fact, as rapid as is obtained from the releasing gear, because of the higher rotative speed of the engine.

Another feature of great importance in this gear, particularly with compound engines, or where moments of excessive overload occur, is its ability to cut off at three-quarter stroke, while the Corliss gear is limited to about half stroke.

The small floor space occupied may or may not be of special interest to the purchaser. In most cases floor space is valuable and often extremely so. The compact form of this engine recommends it particularly to those who are limited in this direction.

While the engine that has been described is eminently suited to any service requiring stationary engines of the highest efficiency, it has special features of adaptability to the work of driving electrical dynamos built upon the engine shaft and free from any encumbrance, and may each carry a dynamo, or belt wheel if desired. It has already been described in regard to its rotative speed and close regulation, both of which add greatly to its value in this service.

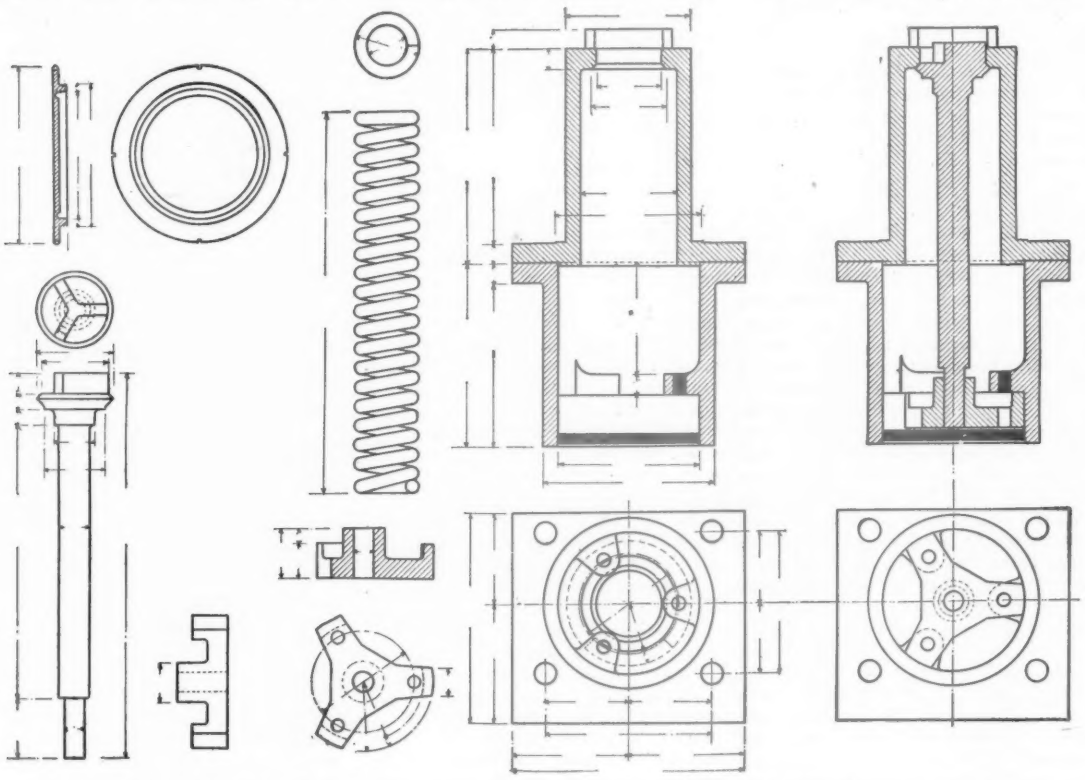


FIG. 3.—SECTIONAL VIEW OF RELIEF VALVES OF THE BALL & WOOD COMPANY'S NEW VERTICAL ENGINE.

ELECTRIC LIGHT FLASHES.

Fairfield, Ia., will have an incandescent electric light plant in operation within 60 days.

Lancaster, Wis., is agitating the subject of electric lights. Much division of sentiment on the subject is manifest.

The incandescent lighting plant at Fond du Lac, Wis., which was recently wrecked by lightning, is again in running order.

The proposition to bond the city of Grand Rapids, Mich., for an electric lighting plant has been carried by a vote of 5,022 to 2,120.

Edison Electric Illuminating, of Brooklyn, net earnings for March, $13,851; increase, $1,634; and from January 1 to March 31, $52,257; increase, $10,550; amount applicable to dividend, $50,800; increase, $13,472.

C. T. Oliver's suit against the Denver Consolidated Electric Light Company for $25,000 for injuries received while attending an illuminating lamp from an aerial wagon in August, 1892, has been decided against the plaintiff.

Edison Electric Illuminating, of New York, earned gross for March, $112,605, an increase of $9,649, and net, $60,196, an increase of $16,603. Operating expenses decreased $6,954. From January 1 to March 31 net earnings were $210,025, an increase of $45,248.

Mayor Schieren, of Brooklyn, N. Y., was somewhat disappointed last week when he learned that Chief Engineer Martin of the Brooklyn Bridge had not prepared a report of the cost of lighting the bridge cars with electricity. Mr. Martin had an entire month to make his report, and the best he could do was to report progress.

The Savanna, Ia., electric light war is now on in good shape. When the second company opened up for business it reduced the price of arc lights from $6 to $5 per month, and of incandescents from 75 to 65 cents. Now the old company has cut the price to $1 for arcs and 25 cents for incandescents, and the end is not yet.

The selectmen, of Marblehead, Mass., have called a town meeting for Friday evening, April 20, to see if the town will instruct the electric light committee as to the location of the electric light plant, and also to see if the town will reconsider the vote whereby it voted to appropriate $10,000 for the electric plant, to be assessed on the polls and estates this year.

The International Trust Company, of Boston, has taken possession of the works and business of the Belfast, Me., Illuminating Company under its mortgage, as representatives of the holders of the company's bonds, and appointed N. F. Houston, agent. Mr. Houston will manage the business of the company, and has continued Percy C. Peirce as superintendent of the works.

The Edison Illuminating Company, of Milwaukee, Wis., has decided to reduce the price of electric light. The change goes into effect immediately and will be of especial benefit to large consumers. The cost of incandescent light will be one cent per hour for each 16 candle power lamp, subject to a discount of 25 per cent. on monthly bills of $25 and a discount of 50 per cent. on monthly bills over $50. The minimum charge to any consumer will be $1 per month. The discount allowed heretofore was 5 per cent. on all bills up to $50, and 10 per cent. on bills of more than that amount.

According to the report of the superintendent of lamps, the total cost of lighting the city of Boston for the past year was $572,293.70, of which $225,776.82 was for electric lighting, $169,919 for gas, $92,462 for lighting and care, $59,464.79 for naphtha lighting, $9,069.83 for repairing lanterns, $6,200 for salaries, $8,428.73 for underground work, $1,405.55 for electric light construction. There are 8,764 public gas lamps, automatically regulated to four feet consumption each hour. The 12 large gas lanterns, consuming from 15 to 30 feet of gas each hour, will be discontinued at an early date and electric lights substituted. The naphtha lamps number 2,803, and are lighted by the Rising Sun Street Lighting Company at a contract price of $21 per lamp per annum. Of electric lights there are 1,580.

Affairs of the General Electric Company.

AN INTERVIEW WITH PRESIDENT C. A. COFFIN.

President C. A. Coffin, of the General Electric Company, was seen at the Schenectady works one day last week and gave me the following facts regarding the physical condition of the company:

The advantages of Schenectady over Lynn as a manufacturing point are numerous. Primarily its geographical location is much more advantageous. It has excellent railway connections and is in closer touch with the territory in which the company's goods are distributed. Another primary advantage is the concentration which promotes efficiency, and which makes a great saving in expense. The idea which has thus far been carried out, and which is to be followed, is to use the Schenectady works for the manufacture of the heavier apparatus, making the lighter goods at Lynn.

In the annual report under the head of "assets," patents and franchises were inventoried $8,159,264. I asked President Coffin what these patents were and especially as to the identity of those which gave the company an absolute monopoly of the business. He said that among others were the three wire systems for incandescent lighting, automatic current regulator for arc lights, the Brush company's double arc lamp feeder patents, etc. The street railway patents are in process of adjudication. They are being infringed, but it is expected that ultimately the company will secure its rights. The larger proportion of this "asset" item consists of the patents. The stocks now on hand are one-third less than they were a year ago. Their inventoried value is also placed at a lower figure.

The plant is within easy walking distance of the city of Schenectady; is conveniently arranged, and has plenty of acreage in which to spread. It consists of 46 buildings, 25 of which are brick, about two-thirds of the brick structures being one story in height. The aggregate of floor space occupied is 12 acres. The number of men employed is 2,500, which is double the number employed during the Summer. The total capacity is 4,000. The works are working full time of 59 hours per week. Nearly all the labor is skilled, and, with few exceptions, consists of men.

With the exception of the manufacture of incandescent lamps, which is done at Newark, N. J., all the work for all kinds of apparatus turned out by the company, which constitutes all electrical apparatus used, is done at the plant. This means that the start is made from the raw material and the process continued to the setting up and testing.

The foundry is constructed on a very large scale and is capable of making all but the heaviest castings used in special designs. It is equipped with furnaces, lifting cranes, etc. A few of the large castings are made in Connecticut. A brass foundry of considerable size is a very important department, as a large portion of the company's apparatus employs brass goods. In the pattern department, a very extensive carpenter shop is continuously at work upon the manufacture of new designs. The patterns have been accumulating since 1886. They cover all the apparatus ever made by the company and are regarded as an exceedingly valuable asset. It was noted that the pattern department is considerably more active than many of the others. As work begins here, the fact is taken as indicative of future activity.

The machine shops are extensive and thoroughly equipped. The equipment is such that every piece of work can be handled in the most economical way. At a rough estimate, 40 per cent. of the entire labor is employed in the machine shop department.

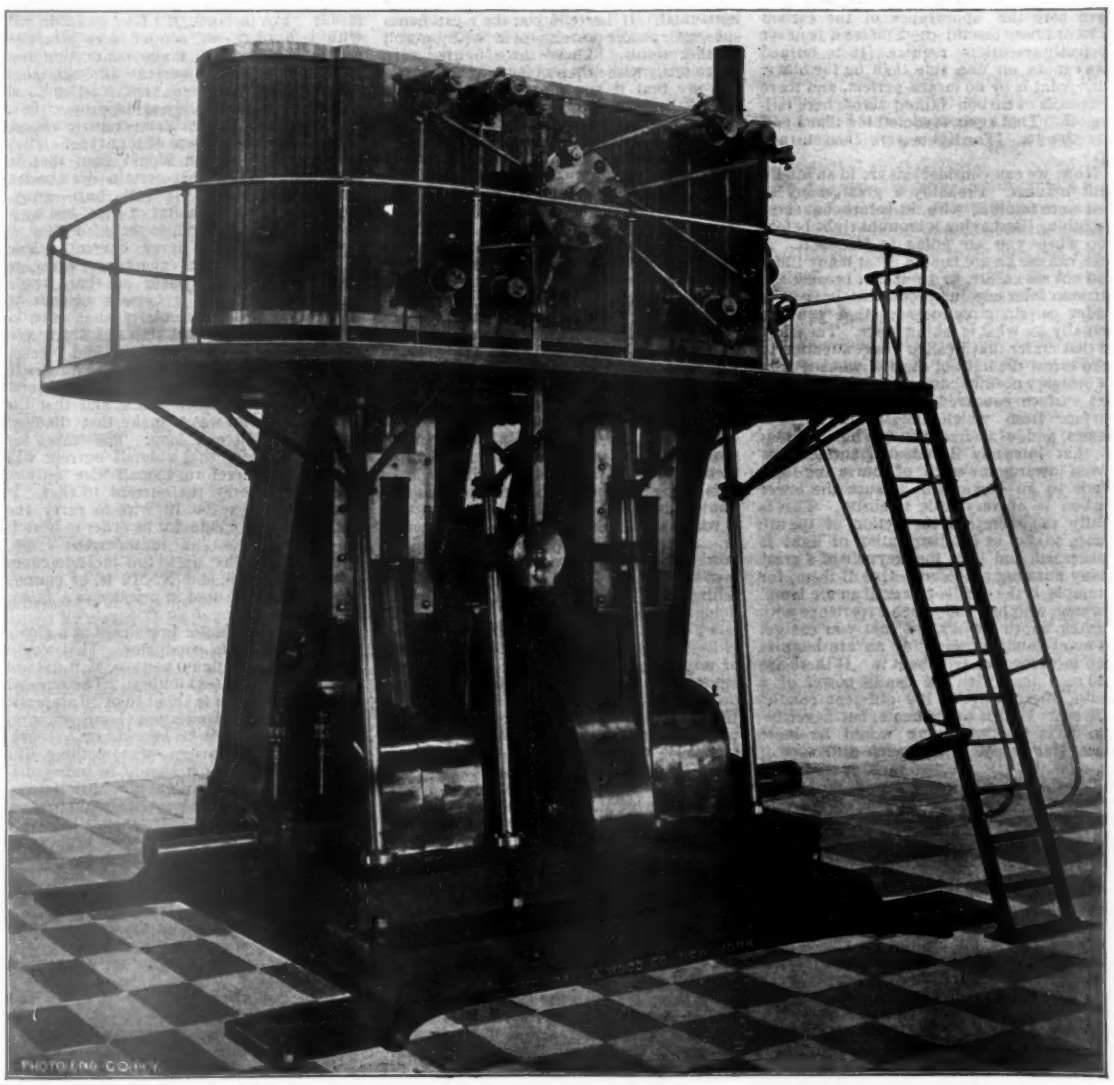


FIG. 1.—FRONT VIEW OF THE BALL & WOOD COMPANY'S NEW VERTICAL ENGINE.

At the present time there is about twice as much work being done at Schenectady as at Lynn, while the work performed at Schenectady is considerably less than the volume of business before the panic. The present volume of work at the Schenectady plant is from one-half to two-thirds of its capacity.

The company started in May and June to do a cash business and is now operating exclusively upon that basis. The system has been very advantageous, and the company proposes to keep it up.

The business which it is losing in refusing credits is bad business and the company is better off without it. The affiliated organizations like the illuminating properties, which were formed to financier the stock and bonds of local companies in need of apparatus, in the interest of General Electric, are in full operation and are doing excellent work. They enable General Electric to receive cash for its goods.

The tube, cable wire, porcelain insulating works and testing department would each make a large factory.

One building was devoted to the insulation of wire. This business was formerly owned by the United States Wire and Cable Company. It is now owned by General Electric.

The most noticeable general feature about the works was the activity in those departments which manufacture supplies as compared with the departments making new apparatus. Work in the supply department appeared to be at the maximum. Officers of the company report that the supply business has been good through the depression, and that now, despite an increased demand for new apparatus, it continues to increase.

At no point about the works were very large stocks of manufactured goods. However, the apparatus in process of manufacture is large, and, as it is expensive, it is fair to conclude that large sums are locked up therein.

BAIN.

ELECTRIC RAILWAY NOTES.

Water Commissioner Holman, of St. Louis, is relaying the water pipes damaged by the Suburban Electric Railway return current and will send the bill for the work to that company.

The East Chester Electric Railroad Company has begun the work of laying its tracks through the streets of Mount Vernon, N. Y. The company has promised to have cars running by June 1 next.

The Paris-Lyons Railway Company has followed the recent lead of the Paris Havre company, and initiated the use of electric locomotives for running its trains. The former company has decided to abandon entirely steam as a motive power. The express trains of the Lyons company to Nice are now run by electric engines. One feature of the engines is that the entire fore part is wedge-shaped.

A gang of 20 men began work on the Tiffin & Fostoria, Ohio, electric railway last week and the force will be gradually increased as more men can be used. The work has been at a standstill since last December on account of financial matters, but now all the clouds have been cleared away and President R. W. Brown announces that the road will he completed as rapidly as the work can be done. The line will be 14 miles in length. The company is also figuring on putting in local lines in Fostoria.

As one result of the number of accidents which have already occurred upon the trolley lines, the Philadelphia Traction Company has decided to adopt the suggestion made by a number of physicians of the city not long ago and provide the cars with axle bells similar to those upon the cable cars. Several of the Thirteenth and Fifteenth streets cars have already been fitted with them as an experiment, and it is probable that all will have them within a short time. These bells ring continuously while the cars are in motion.

The new power house to be built by the Cincinnati Street Railway Company on the property recently purchased by assignee G. H. Burrows, of the Standard Wagon Company, on the southwest corner of Depot and South streets, will be one of the most complete in the city. The sum of $17,000 was paid for the ground and the company will spend about $200,000 in erecting a new power house, which will be 140 by 200 feet in dimensions. The house will differ from others in that it will have no smoke stack, big fans being used to carry away the smoke. Bert. Baldwin is the engineer.

The Nassau Electric Railroad Company has purchased a site for the power house which it intends to have within the city of Brooklyn, N. Y. It is located at nearly the foot of Thirty-ninth street, where there is a long strip of land which juts far out into the water. The site will extend from one side of this piece to the other, so that it practically lies between Thirty-ninth and Fortieth streets. It has two water fronts and a width something more than 100 feet. The machinery for the electric welding process, by means of which the rails of the new company are to be fastened together at the ends without noticeable joints, has been delivered at the company's dock.

In the town of Halle, in Germany, says London *Engineering*, a horse tramway was opened in 1889, and worked with horses till July 1, 1891, during which time the working gave a deficit of about £1,900. On July 1, 1891, the electric working of the whole tramway line commenced, and the first 12 months gave a surplus of £2,400, leaving five per cent. on the capital after the regular writings off. The mileage was extended from about five to about seven and one-half miles, and during the last working year it carried some two and two-third million passengers. Halle still possesses a horse tramway, but whilst the receipts of the electric railway are continuously increasing, the horse tramway shows a steady falling off in receipts for the last working year of over £1,700

Electric Lighting.

A LECTURE DELIVERED AT COOPER UNION HALL, NEW YORK, FEBRUARY 14, 1894, BY PROF. F. B. CROCKER.

(*Continued from page 181.*)

Now, I want to show you the arc itself, and one point in regard to it I want to call your attention to—the fact that the lengthening of the arc of course increases the potential necessary to drive it. I have here two carbons simply, mounted in a convenient form so that I can move them further apart by a screw adjustment. (Exhibiting.) In parallel with these two carbons, which are practically the same as the ones I have just shown you, only arranged in a more convenient form, I have an ordinary incandescent lamp which shows the potential. I use that as a voltmeter. It is connected to the two carbons. In other words, the greater the difference of potential between those carbons, the brighter that lamp is. You see as I get that arc further and further the lamp begins to brighten up. (Exhibiting.) That is about 30 or 40 volts now, and as I lengthen it the lamp will grow brighter and brighter. Of course, the arc is broken and the lamp alone has the full potential. I was trying to show you that as the arc increased in length this incandescent lamp increases in brilliancy, because the difference of potential between these two carbons increases almost in direct proportion to the length of the arc. It is the same as if you had two plates in water with a little salt added, the further you moved them apart the greater the resistance between them and the greater the difference of potential. That point, however, is of considerable interest—the exact relation between the different potential here, which is usually about 45 volts, and the candle-power of the arc. It has been found that 45 volts and about nine and a half or 10 amperes is the best voltage and the best current to produce the ordinary commercial light. That is a mere empirical fact, and even that is denied by some authorities. Professor Carhart, of the University of Michigan, has, as the result of certain experiments, arrived at a certain relation between volts and amperes, but Mr. Crompton, of England, has arrived at different results. These men do not differ very much, however, it is only a matter of a few volts and amperes. So you can see that even looked at from the different sides of the ocean, the arc lamp is about 45 volts and about 10 amperes as being the best voltage and producing the best current.

Now, I want to show you the arc itself projected on the screen, because there is nothing like seeing it in a perfectly clear way. The arc is so brilliant that looked at, as I have shown you already, you see nothing; it is simply a dazzling point of light, and it does not show you anything except that there is a very intense light there, but you cannot see how it takes place. I will show it to you now in form that has not that disadvantage. (The arc was then shown on the screen.)

There is the arc in a form that is very easy to handle. I can even touch it. There are the two carbon points, and the current passing across between them, as you see there. That peculiar purplish blue color is really where the arc is. You see the carbons are intensely heated by this arc Even a portion of this carbon would be too brilliant to look at directly, except through a smoked glass, but looked at in this way we can see exactly what process is going on. These carbons are about one-eighth of an inch apart in reality. Projected upon the screen they look much more than that distance apart, as they are magnified by the lense. The diameter of the carbons is five-eighths of an inch. Therefore, this distance here is considerably less than the diameter of the carbons. This arc now, I should say, is a little longer than usual. While it lasts I want to call your attention to that crater. This upper carbon here has what I call the crater. It is an almost flat surface up here curved downward, and this part here has almost a point. This crater here is the secret of the action of the arc lamp, and therefore something; that is really my object in throwing this on the screen. This is the positive carbon, the upper one, and the current passes downward. In fact, you can see it here passing downward. Those are particles of carbon carried down by the current, but they are very rough and crude compared to the actual transfer of energy there. If anybody only knew what was going on across that space it would be the greatest idea that any human being ever conceived of. The characteristic of the arc is this. This upper carbon is the positive carbon, and from it the carbon is torn off and burned away, while the lower carbon is only slowly consumed. Consequently, the upper carbon has to be considerably longer than the lower carbon in order to keep the lamp in operation for any length of time. The upper carbon, furthermore, is the principal source of light. This lower carbon is comparatively dull. You see even now that just the tip of it is bright, but not as bright as this part up here. The upper carbon is much greater in surface and intensity, and as a matter of fact I suppose seven-eighths of the light comes from the upper carbon.

I call particular attention to that fact, because that is a fact that I am going to use as the text of a few remarks about the arc. You see this burns away, and when it burns away too far you want to feed it together again the proper amount, the feeding keeping it at the proper distance. You can move up the lower carbon and move down the upper carbon. You see the carbon here is incandescent up for some distance, and there is some material on the lower surface that partly falls down and partly is carried down by the current. This looks as if the current flowed across from the positive to the negative carbons, but I can show you other experiments where it looks as if the current flowed the other way; in fact, in many cases the so-called negative pole is more active than the so called positive pole. In the case of the arc lamp it looks extremely positive and negative, because everything seems to take place across here from the positive to the negative pole, but that is more an accident than any very important phenomenon. You all realize that these carbons are magnified almost 100 diameters, and you have here the appearance of the carbon in its ordinary condition. You see it is never perfectly smooth or regular. It is burned away more on one side than on the other. This point is by no means perfect, and there are pieces of carbon falling across here falling off. That again is something that I call attention to. (The lights were then turned up.)

Now, we can consider this arc in an intelligent manner. Probably a great many of you were familiar with it before, but there is nothing like having it brought right before you when you are going to discuss it. A man can see an arc lamp a great many times and not see an arc, so to speak, because the arc is so intensely luminous that it is only under certain circumstances that you can actually see what is taking place. The effect of that crater that I called your attention to is to throw the light of the arc, when it is in its ordinary position, downward, because that flat surface concaved downwards was—the surface from which almost all the light comes, and, of course, you can imagine that if that intensely illuminated surface concaved towards the earth, of course the light tends to go downward, because the lower carbon is of very little intensity. That is really the secret of the action of the arc lamp, so far as its distribution of light is concerned, and it is the keynote of a great many puzzling problems. One of them, for example, is the candle-power of an arc lamp. Anyone who has had much experience with electric lighting will know that you can get as many candle-powers for an arc lamp as you have men to tell about it. If there are 100 men that give the candle-power of a lamp, there will be 100 different candle-powers. That is unfortunate, but nevertheless it is true. Nothing would be more unsatisfactory than any such difference of opinion, if it can be called such, or confusing state of affairs which exists in regard to arc lamps. The arc lamp, of course, is a very intense light, but nevertheless it does not run up into thousands of candle-powers, and it is proper to know exactly what the arc lamp does have.

This (exhibiting the arc lamp) is to give you an idea of the arc lamp. This represents the carbon here in front. I have tempered the light a little bit by the interposition of the screen, which enables me also to plot the curves on it. In this direction, between 40 and 45 degrees downward, you have the maximum intensity of the arc lamp. The reason for that is obvious, because this surface up here is the source of light, and, consequently, the light is thrown downward. It could not be thrown directly downward, because this carbon would interfere. It is thrown downward at a certain angle. Now, in this direction here the amount of light is much less than in that maximum direction there. The direction in a horizontal line is usually about one-third of what it is in this line here. The distance from the center of the arc here to that point there is approximately one-third of what that is. When you come to this distance up here, there is almost no light thrown up. Even that is shut off by this upper carbon, so that very little light is thrown upward. You will notice here that the light is thrown downward rather than upward. It is a fact that is very true, whether it is apparent or not. Now, this curve here represents the amount of light in any given direction. If you draw a line from that center down, its length between will be the intensity of the light in that direction, and that in that direction, and this horizontally in that direction. Now, the average intensity of the light in the lower hemisphere is represented by this curve. The average of the intensity for the entire sphere, which this light illuminates, that is, in every direction, is represented by that smaller circle there; so that this curve represents the actual distribution of energy, and from that center in any direction you can tell what the intensity of the light is by running a straight line there and seeing how long it is compared with this one. This longer curve represents the average light for this lower hemisphere. The average intensity of that light in every direction is that. The average intensity of the light for the lower hemisphere below the horizontal line is represented by this outer circle.

Another way to see that the arc lamp throws its light downward is shown here (illustrating). You see now that it is not at all intense; in other words, you are not getting a strong light. If you throw it this way (illustrating), you see it is much more intense. When you pull it backwards it is very much less intense, but when you push it forward so as to throw that 45 degree line into your line of vision then it becomes very obvious.

Now, these three curves here are the three curves representing the real intensity of the electric light, considered from various points of view. When a man tells you the candle-power of an arc lamp, he may tell you any one of those there. For instance, suppose he tells you that maximum. Obviously he will give you a greater power than if he tells you the horizontal, measured here. If he tells you the mean spherical candle-power, which is that, it will be still less than the horizontal. If he tells you the mean hemispherical candle-power, there will be still another result. Those three figures vary enormously with different lamps. Of course, you see that if you measure it one minute you get one value, and the next minute you may get another value, and so on, but by a number of repeated observations you could get an average result.

Taking those things in that way, so far as I can make out, the ordinary arc lamp of 45 volts and nine and a half or 10 amperes—this maximum candle-power in that direction there—the greatest candle power you can get will be about 1,000 to 1,200; that is, assuming that 1,000 to 1,200 is the basis, the horizontal candle-power will be about 300, we will say. Then, the average hemispherical candle-power below this horizontal line will be about 450, and the average spherical candle-power will be something like 350. Those are three different candle-powers: 1,000 for the maximum, 300 for the horizontal, 450 for the mean hemispherical, and 350 for the mean spherical candle-power. Those four figures are all four of them correct in themselves, but if a man tells you one of those figures you want to know which one he is telling you, and that is where a great deal of the confusion comes in. A man sells his arc lamp by this candle-power, and he will buy it by that one. The man who is buying and the man who is selling should each know what they are doing. This confusion about electrical matters I do not think has contributed anything to its progress. There has been a great deal of misrepresentation of figures, partly from ignorance and partly from intention, and I do not think it has done anybody any good. But when it is from ignorance the best way to overcome it is to tell people what the trouble is. It has bothered me for years to know this great discrepancy between these different candle-powers, and this is a good explanation of it. Furthermore, you have seen the way it fluctuates and sputters around. That again introduces a source of error and no two arc lamps, although carrying the same volts and meters, will agree, and no two observers will agree, so the opportunity for deception is very great. That difference between observers and between two arc lamps is all reasonable enough, but for a man to tell you that the way to get at the average candle-power of a lamp is to measure the maximum and call that the average, is a positive fraud, if he knows what he is doing, and if he does not know what he is doing it is a very fortunate accident for him.

Those figures that I have given you are fairly good average figures, but, of course, another lamp would possess a different figure. So far as I can find out, those are results which can be obtained and which ordinarily are obtained. You could do better and you might do worse than that. Some lamps will test over 300 candle-power in the maximum line. So it would make a difference.

One interesting point is that the temperature of the upper carbon is about 3,500 degrees Centigrade. M. Moissau, a very celebrated French physicist, has made some very careful determinations of this point, and he has determined that the upper carbon, this heated crater, has a temperature of about 3,500 Centigrade. That is an enormously high temperature, because you know that cast-iron melts at about 1,000 Centigrade or below, and that almost any metal, except platinum, melts at about 1,000, and that platinum itself melts at 1,700 degrees Centigrade. This temperature is almost twice the melting point of platinum; therefore, almost every known substance is readily fusible in the arc. You can put almost anything in the arc and it is fusible; in fact, carbon itself is fused, and carbon is one of the most, if not the most, infusible substances known.

Now, we will take up the incandescent light, and I will show you some little points about that of what I consider the keynote. In the first place, you all know that if we pass a current through a wire, if the current is of considerable power, we will get a heating of the wire, and if the current is very powerful the wire will become incandescent and red-hot; hence, the name, incandescent lamp. There is no trouble at all in fusing a wire by electric current if you have enough current and a small enough wire; in fact, that is the whole question. Each wire of a given size has a current which will just raise it to the incandescing point, so to speak. When the wire loses as much heat by radiation as the current puts into it by its effect in passing through the so-called C^2 R effect—when those two are equal the wire keeps a constant temperature. It is perfectly evident that it would be very difficult, if not impossible, to keep that wire at anything like a constant temperature by means of this device here. (Exhibiting and illustrating.) That showed what I wanted to show, that you cannot keep it at a constant temperature, except by a more perfect device than that. The ordinary heating of the wire is something of a rough effect. We can get a steady effect by the use of more perfect means. For instance, if I take a carbon rod with two pieces of copper wire wrapped around the ends to make connection to it and then pass the current through that (illustrating), you see that carbon rod becomes hot fortunately at the proper time. That keeps a constant temperature. Some of the early lamps were of that type. They had a rod of carbon bigger than that, in some cases. That has certain drawbacks. In the first place, it will burn away. Furthermore, the amount of heat lost by it will be very great, and, in the third place, it would take a very large current. You would have to have enormous wires to supply any such system as that would require. Therefore, it became evident to all the workers, particularly such men as Edison and Sawyer and Man and Swan, and a number of other American and foreign inventors, that the proper thing to do was to take the filament or the heated conductor and put it in a sealed globe, and that the next thing to do was to make that filament small and thin and long. The reason for that is, in order that a small current will heat it, and, therefore, a small wire only is required to carry the current to that. It would require a No. 10 wire to carry the current to this conductor in order to heat it red-hot. Whereas an incandescent lamp, you can bring that up to full incandescence on a No. 20 wire, and No. 16 is, of course, the ordinary size used in practice as a factor of safety.

Now, the conductor is inclosed in a globe. This is a very thin conductor. That would not make a bad light, you see, if it did not burn up too soon (exhibiting). The number of amperes—there is about 10 or 12 amperes. The proper incandescent lamp requires something that will be brought up to incandescence with a current of something like one ampere or less; it should be indestructible, so that the air does not burn it away when exposed in that way; it should be separated from the air in order that it shall not by convexion lose a great deal of heat, and a number of other practical difficulties would arise if any crude system like that were adopted. The electric light with the filament, with which you are all perfectly familiar, the thin carbon filament, in a glass globe enclosed in a vacuum, is the practical form of incandescent electric lamp as we have it to day.

(*To be concluded.*)

Young Men's Institute.

On Monday, April 30, and Tuesday, May 1, during the day and evening, there will be a large exhibit of drawings made by members of the free-hand, mechanical, architectural and carriage drafting classes, also manuscripts from the penmanship, bookkeeping, shorthand and typewriting, arithmetic, steam engineering and electricity classes of the Young Men's Institute, 222 Bowery, New York.

Anyone interested is welcome to visit the rooms and inspect the work done by the pupils. On Tuesday evening, May 1, the closing exercises of the classes will be held in the Institute hall. Certificates of progress, diplomas and prizes will be awarded, and there will be special music and addresses.

The work of the school year 1893–'94 has been very satisfactory, with an enrollment of about 635 young men in 11 studies, and the committee are planning to add one or two new subjects to the curriculum for 1894–'95

The Fall term will begin October 3, 1894. Enrollment can be made any time during the Spring, Summer or early Fall.

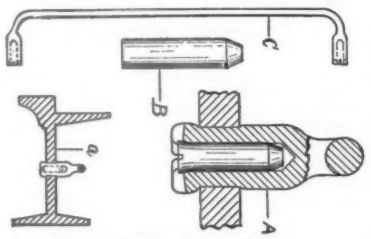
The General Electric Company at the Midwinter Fair, San Francisco.

The representation made by the General Electric Company at the Midwinter Fair which, of course considerably less important than that made by them at Chicago, from the point of view of quantity, is still among the most important of the electrical exhibits which are now supposed to be delighting our Western brothers by the Golden Gate. The display of its purely mechanical exhibit is made in the Palace of Mechanical Arts, and the space allotted is occupied by many of the later types of its machinery, apparatus and instruments, the major portion being devoted to a fine exhibit of electrical mining and power transmission apparatus.

The chief use of electricity on the Pacific coast is to transmit power to the cities and towns for railway and lighting work, and to the mining centers for the operation of the different electrical mining apparatus, such as drills, crushers, pumps, etc. The field of power transmission is very wide in the States west of the Rockies, where coal is extremely costly, but where, on the other hand, there are many available water powers which are fast being utilized. Among other apparatus the General Electric Company exhibits the following:

A three phase rotary four pole transformer similar in design to those now in use at Redlands, Cal., and to those which will be used at Niagara Falls. It resembles a continuous current transformer, in which the primary and secondary are wound on the same armature. It is wound for a potential of 200 volts at the receiving or motor brushes, while the potential of the three-phase current is 500 volts.

The most important feature is a complete three-phase power transmission plant. The



THE CHICAGO RAIL BOND.

generator is of 35 kilowatts capacity, and is driven by means of belting by a 35 kilowatt bipolar motor. The current of the generator is led to a switchboard containing the usual set of instruments, such as Thomson-Houston indicators, recording wattmeters, switches and fuses, and the "line" is carried on oil insulators, after having been transformed in the step-up transformers from a potential of 300 to one of 6,000 volts, to the switchboard of the receiving station. Step down transformers are then employed, which reduce the voltage to 300, under which pressure the current is delivered to a 10 horse-power three-phase motor, which is belted to what is generally termed a "drill" generator, a dynamo having rotary brushes, used to operate percussion drills. The drill exhibited is of the General Electric percussion drill type. Connection is made by means of a cable armored for its better protection in mine work.

A 10 horse-power mining locomotive, 24 inch gauge and equipped with two 500 volt iron-clad motors, also forms part of the exhibit. This locomotive is well adapted for mine work, as it is built very low for entrance into low gangways. The seat for the motorman is in front, and all operations, such as starting, stopping, reversing, applying sand to the rails, etc., can be quickly done, the handles of the levers for these operations being all within easy reach. Two 16 candle-power lamps in a reflector form the headlight.

Portable mining outfits are also shown, one consisting of a special motor running a swiveled diamond drill by means of bevel gears, which can be thrown out of mesh so that a friction clutch allowing of connection of the motor to a hoist can be thrown in, the motor serving for the two different operations. On the same truck with this apparatus is also mounted a three kilowatt Edison motor connected to a triplex Gould pump.

There are also set up and in operation a rotary pump, driven by means of a rigid coupling from a three kilowatt Edison motor mounted on the same base, the pump delivering about 300 gallons a minute; another portable pump outfit, consisting of a three kilowatt Thomson-Houston motor connected by two intermediate gears (the pinions being of rawhide) to a Gould triplex pump, delivering about 100 gallons a minute, the whole being mounted on a truck. A 10 horse-power sinking pump for deep mine work, perfectly water tight. All these pumps are working with very little noise and vibration.

A board filled in regular style with instruments, such as wattmeters, indicators, fuse blocks, railway supplies, etc., a few fan motors, which attempt to make things lively by means of colored ribbons attached to their frames and floating in the air currents produced, a 24 inch projector, marine type, four large ball clusters on poles, containing each forty 16 candle-power lamps, and two cubes of fifty-four 16 candle-power each, complete the exhibit so far as the exposition space proper for the company is concerned.

A 200 kilowatt railway generator furnishes current for cornice lighting, the lamps being connected five in series, as well as for the motor of the tower elevators. This is driven by a double piston valve engine of the Joshua Hendy Machine Works, of San Francisco, cylinder 14 inches by 18 inches, belt connected. This dynamo is on the opposite side of Machinery Hall, near the boiler house, where are also eight Thomson-Houston arc light machines, each of 50 lights. These are driven, four each, from two countershafts, which in turn are belted, one to a Buckeye automatic cut-off slide valve engine of 200 horse-power, 140 revolutions; cylinders 14 inches by 2 inches (the speed being controlled by the isochronal regulator); the other one to a 150 horse-power Russell engine of 190 revolutions, cylinder 13 inches by 20 inches and fitted with the Russell automatic cut-off slide valve and fly-wheel governor.

The Annex shelters a 150 kilowatt Edison dynamo, supplying current for the electric fountain and the search-light on top of the electric tower. This machine is belted to a 250 horse-power tandem I. F. Thompson slide valve engine, manufactured by the Golden State and Miners' Iron Works, of San Francisco. Near by is a 6,000 light alternator driven through the intervening medium of a countershaft from a 500 horse-power Corliss engine of 80 revolutions per minute, and cylinder 22 inches by 48 inches.

The search-light on top of the electric tower is that which was exhibited at Chicago. It is a 60-inch projector with a Mangin s herical mirror, and is one of the largest in the world. The fountain is one of those which played at the World's Fair and has been fully described by us. In its new position it is much better situated for display and is not subjected to the violent competition of surrounding white buildings and blaze of light.

Measurement of the Capacity of Condensers with Alternating Currents.

J. Sahulka, in *Electrotechnische Zeitschrift*, calls attention to the fact that condensers with solid dielectrics have a greater capacity when measured with direct currents than that found by alternate current methods. He explains this by the fact that "soaking" of the charge occurs with direct currents and takes an appreciable time, and that part of the quantity of electricity which passes into or out of the condenser by reason of this soaking is measured by the galvanometer in direct current methods. When charge and discharge, on the other hand, take place with great rapidity, as in an alternating current method, there is no time for soaking, and the quantity passing in and out is therefore less. He proposes to define the capacity of a condenser for alternate currents as follows:—The capacity of a condenser in an alternate current circuit is equal to the reciprocal of the product $2\pi n$, multiplied by the inductive resistance; the latter being the quotient of the volts in the condenser divided by the current flowing in its circuit. As an instance of the kind of difference which occurs, a condenser made of paraffined paper, and having a capacity of about one microfarad, was reduced in capacity by 14 per cent. on an alternating current.

American Metrological Society.

In accordance with the vote of the council of the American Metrological Society the annual meeting will be held in Washington, D. C., on Friday, April 20, at 2 P. M. The place of meeting is the Columbian University. Papers of interest are expected. T. C. Mendenhall will report on the International Electrical Congress at Chicago. A. A. Michelson will give an account of his work at the International Bureau (near Paris) in determining the value of the meter in terms of wave lengths of light. The committee on color standards will make an interesting report.

Telephony Without a Wire.

The Abbé L. Michel contributes to *Cosmos*, Paris, March 3, a paper translated in the *Literary Digest*, describing some interesting experiments in telephonic communication without a wire.

He names three possible means by which the spoken word may be transmitted electrically without the intervention of a conducting wire, namely, electro-static induction, magnetic induction and conduction by the earth.

Electro static induction is exemplified by the fact that, when an isolated body is

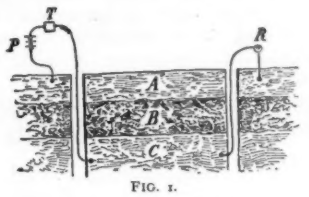


FIG. 1.

TELEPHONY WITHOUT A WIRE.

charged, another body placed in its vicinity receives a charge of the opposite electricity, and the message may be transmitted by a series of successive charges and discharges. The method is not, however, a very practical one, as it requires enormous isolated surfaces for relatively short distances.

By magnetic induction a current in a conductor produces in another parallel conductor a second current of opposite direction when it starts, and one in the same direction when it stops. Two parallel lines on a long course and not too far apart react on each other so that a telephone placed on a telegraphic route will convey the tic-tac of the Morse transmitter. Mr. Preece has succeeded in transmitting the sound of Morse signals to

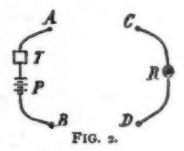


FIG. 2.

CIRCUIT CONNECTIONS.

a distance of three or four miles, with parallel wires six kilometers in length. But this system is not always possible, and promises no very important practical results. Still it might be used advantageously at a pinch.

The third system, the transmission of signals through the earth, is more simple, less costly and much more practical. Here, too, there are two different methods of procedure: In the first, two conducting layers of earth, separated by a third layer of greater resistance, can be utilized for a conductor and for the return current.

In Fig. 1, A is the surface of the soil, B a

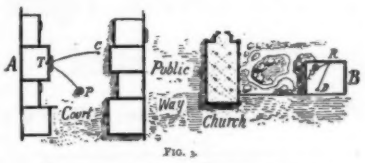


FIG. 3.

LOCATION OF THE EXPERIMENTS.

resisting layer, C a layer of greater conductive power. The current of the pile P, traversing the transmitter T, reaches the earth at the surface and takes for its second conductor the layer C. At the other extremity of the line the receiver R receives the current at C for transmission to the surface. A great part of the electric current is lost in traversing the intermediate layer, but there remains sufficient to determine a perceptible difference of electric tension between the layer C and the surface. The current is capable of operating a telephone receiver, and if the conditions are favorable a delicate relay can set a bell in motion.

Telephonic communication may also be established by a current derived from the homogeneous surface soil. In Fig. 2 the current of the pile P, traversing the transmitter T, completes its circuit by contact with the earth at A and B. The current dispatched by the pile to B tends naturally to pass directly to A, but in consequence of the resistance of the soil there remains a slight difference of tension between the most distant points, C and D, in consequence of which there is set up in the wire uniting these two points a current sufficient to operate the receiver R and make it repeat the spoken or other signals of the transmitter T.

Guided by this principle I constructed a telephone of which the following is a description:

The building A, Fig. 3, is separated from the house B by a court, a row of houses, a roadway, a church and a garden, a total distance of 120 metres. The transmitter T in the building A, traversed by the current of a battery of five accumulators, is connected with the earth by contact at C and at the well P. The receiver in the house B receives the current in the well P and at the point D, distant about 6 metres from each other.

Now for the results! A melody, sung before the transmitter in the house A, is heard distinctly in the receiver R, a distance of 120 metres, and in a chorus the several voices could be distinguished. The spoken word is very difficult to understand, because, to secure the greatest variation of current, one is obliged to talk very loudly into the transmitter, and this occasions crackling sounds which greatly alter the consonants; nevertheless, I succeeded in understanding clearly enunciated phrases. Morse signals made at A are reproduced very distinctly at the receiving place B. The current arriving at the receiver will be strong enough to act on the needle of a good galvanometer, if it be provided with two wires, so that the ordinary earth current may be neutralized by means of a weak battery. From an office 900 metres distant my receiver R allows telegraphic dispatches to be heard quite distinctly—sufficiently so to be intelligible above the din of external noises.

In this experiment there can be no doubt that the effect is not due to induction. The current is conveyed by the earth, by different layers—the surface soil, and the water or other elements connecting the bottoms of the two wells—but the transmission can be effected also at the surface of the soil, according to the last announced theory. To demonstrate this I temporarily replaced the contact with the bottoms of the wells by contact with the surface. The results were less favorable, but still satisfactory.

Be that as it may, it is demonstrated that the spoken word may be transmitted electrically to a distance without the intermediation of a wire conductor. Telephony without a wire is a fact; nothing remains but to perfect the methods.

The Chicago Rail Bond.

One of the most vital questions to the electric railway engineer is the bonding of the rails. Realizing the importance of this matter the Washburn & Moen Manufacturing Company, of Worcester, Mass., have recently developed the Chicago rail bond, which is shown in detail in the accompanying illustrations.

The rail bond C is a copper rod or wire having tubular or thimble-shaped terminals which are bent at right angles to the bond, and with its two tubular terminals is composed of one solid piece of rolled copper.

The tubular or thimble-shaped terminals A are inserted into holes through the web of the rail *a*, and the slitted end of the terminal A is spread or clinched over on the rail with a hammer or punch; this holds it from drawing back out of the hole.

The drift pin B, which is larger than the opening in the tubular or thimble-shaped terminal A, is then driven into the terminal, thus expanding it and wedging it into solid contact with the surface of the hole through the web of the rail *a*, making an absolutely solid joint from which every particle of air and moisture is excluded and proof against corrosion or electrolysis.

These bonds can be furnished in any length, and are being extensively adopted.

KINDRED INTERESTS

The Fort Wayne Electric Company has just closed a large contract to put in a city lighting plant at Austin, Texas.

H. T. Porter, New York agent for the Buckeye Engine Company, of Salem, O., is now comfortably installed in his new offices at 39 and 41 Cortlandt street where his many friends are assured a welcome.

Frank H. Stewart, Philadelphia, manufacturer and dealer in general electric supplies, has removed from 1208 Green street to 41 North Seventh street, in order to be more centrally located and to increase his facilities for carrying stock.

Mr. R. K. Dana, 16 Cliff street, New York, agent for the Washburn & Moen Manufacturing Company, of Worcester, Mass., reports an improvement in business and states that the Chicago rail bond, recently placed on the market by his company, is rapidly winning popularity.

Cushing & Morse, 225 Dearborn street, Chicago, general western agents for Kerite wires and cables, are sending out a very artistically printed leaflet entitled "Red Tape *vs.* Kerite Tape" and a little envelope containing sheets of court plaster which does not stick as well as Kerite tape. Write for both these advertisements if you are a tape user.

Clapp & Company, of New York, have issued their handsome book of statistics for 1893. It contains not only a complete file of their market letters and illustrations of leading American exchanges, but the quantity and government values of American products, grown, mined, or fished, as also their export values, as well as the amount of gold and silver coined yearly and since American mints were established, and the price of silver yearly for 60 years. It also contains stock, bond and interest tables, bank stocks and clearing-house records. To the student of statistics the book is invaluable.

Messrs. Curtis & Curtis, of Bridgeport, Conn., manufacturers of the Forbes patent die stock and all kinds of pipe working tools and machinery, find that their labor saving machinery and tools are coming into such general use abroad, that they have decided to send out one of their firm to consult with their agencies, which are scattered throughout Europe, and to look after their interests generally. Mr. Lewis B. Curtis expects to sail on May 16, and will be absent about three months. They inform us that they are running their works with a full force, and are very busy with both foreign and domestic orders.

Dixon's Graphite Cycle Lubricant.—The Joseph Dixon Crucible Company, Jersey City, N. J., are putting a cycle chain graphite on the market, which for purity of graphite and usefulness is vastly superior to anything of the kind heretofore prepared. The graphite is not only of the choicest stock, but is ground to an impalpable powder, and then reground with a high grade of lubricating oil. This material, when applied to a chain of a bicycle, penetrates the bearings and thoroughly lubricates and protects them from wear and rust. The Dixon company will shortly put the same material on the market in the form of a solid stick, for the convenience of wheelmen who wish to carry it in their tool bags.

When Queen & Company, Philadelphia, produced their well-known T 305 testing set they made a very important advance in the matter of portable testing instruments. Still their electricians were not satisfied to let this remain and devoted themselves to further study of the problem. The researches of Ayrton and Sumpner on the D'Arsonval, supplemented by extended experiments in the Queen laboratories, have resulted in a galvanometer of increased sensibility, as well as portability. The use of platinoid wire having very high specific resistance and the careful proportioning of coils enabled them to very much diminish the size and weight necessary for the bridge, so that the whole testing set is now contained in a box 3x6x5 inches. When it is considered that this set comprises a Wheatstone bridge having a theoretical range from .001 to 10,000,000 ohms, a silver chloride testing battery, D'Arsonval galvanometer and necessary double contact keys, one appreciates the great advance made possible by careful study and experiment. Those interested may obtain full information by sending for circular No. 522.

PROPOSALS FOR LIGHTING.

SEALED PROPOSALS for lighting the streets of the City of Williamsport, Pa., for a period of five years from Dec. 1, 1894, with electricity, gas, or otherwise, will be received at the office of the city clerk up to 12 M. of Monday, April 30, 1894. Bidders will state plainly the kind of lights, number, location and candle-power of the same. Said lighting is to be for every night in the year from dark to daylight. Each bid must be accompanied by a certified check for one thousand dollars. The city reserves the right to reject any or all bids.

WILLIAM DREISBACH,
City Clerk.

BEST FOR ALL
Electrical Work

PATENT PERFORATED ELECTRIC LEATHER BELTING

CHARLES A. SCHIEREN & CO.,
Patentees and Sole Manufacturers.
47 Ferry Street, New York.
226 No. Third Street, Phila.
46 So. Canal Street, Chicago.
119 High Street, Boston.

WM. A. ANTHONY,
Consulting Electrical Engineer
and Electrical Expert.
VINELAND, N. J.

CONTINUOUS CURRENT
DYNAMOS
AND
MOTORS.
By FRANK P. COX.
Their Theory, Design and Testing, with sections on Indicator Diagrams, Properties of Saturated Steam, Belting Calculations, Etc.
An Elementary Treatise for Students.
271 Pages, 83 Illustrations.
PRICE, $2.00.
Sent on receipt of price.
ELECTRICAL REVIEW,
13 PARK ROW, NEW YORK.

FREMONT WILSON,
ELECTRICIAN.
Plans and Specifications for Interior Lighting Prepared, and Personal Supervision Given to all Work. Appraiser of fire losses on electrical apparatus.
INSURANCE SURVEYS A SPECIALTY.
Room 1111, Vanderbilt Building, - 132 Nassau St.,
NEW YORK CITY.

POPE, READ & ROGERS,
41 Cortlandt St., New York.
Franklin L. Pope, Robt. H. Read, Ed. H. Rogers.
PATENTS.
ELECTRICAL INVENTIONS A SPECIALTY.

THE LEHIGH VALLEY
CREOSOTING CO.
WORKS, PERTH AMBOY, N. J.
Office, Rooms 136 and 137, 1 Broadway, NEW YORK.
Creosoted Lumber, Underground Conduits, Telegraph Poles, Piling and Ties Furnished.

ELECTRIC LAUNCHES BUILT COMPLETE, $1750. UPWARDS.
THE GENERAL ELECTRIC LAUNCH CO.
44 BROAD STREET, NEW YORK.
ELECTRIC EQUIPMENTS FOR ROW BOATS $350. UPWARDS.

THE CORRESPONDENCE
SCHOOL OF TECHNOLOGY,
CLEVELAND, OHIO.
Correspondence Instruction in Electricity, Steam and other Engineering Branches, by E. P. Roberts, M. E., and Nine other Specialists.

H. WARD LEONARD & CO.,
BULK ELECTRICAL CONTRACTORS,
136 Liberty Street, New York.

SEND FOR THE NEW BOOK.
ELECTRICITY UP TO DATE.
By JOHN B. VERITY. 75 Cents.
ELECTRICAL REVIEW PUBLISHING CO.,
13 PARK ROW, NEW YORK.

WANTED—A young man well posted in electrical matters wants a position. Will come for low wages.
Address "Ampere,"
ELECTRICAL REVIEW OFFICE, N. Y.

POSITION WANTED.
ENGINEER.—One who thoroughly understands the care and management of electric railway power station; will take position in any part of country; good reference. Address
J. T. POCKNELL,
P. O. Box 184. HOBOKEN, NEW JERSEY.

INSTRUCTION BY MAIL
In Architecture,
Architectural Drawing,
Plumbing, Heating and Ventilation,
Bridge Engineering,
Railroad Engineering,
Surveying and Mapping,
Mechanics,
Mechanical Drawing,
Mining,
English Branches, and
ELECTRICITY.
Diplomas awarded. To begin, students need only know how to read and write. Send for FREE Circular of information stating the subject you think of studying to THE CORRESPONDENCE SCHOOL OF MECHANICS AND INDUSTRIAL SCIENCES, Scranton, Pa.
4000 STUDENTS.

PERSONAL RECOLLECTIONS
OF
Werner von Siemens.
Cloth, $5.00.
In two very different fields—the application of heat and the application of electricity—Herr von Siemens gained pre-eminent distinction by his rare combination of scientific insight and power of practical utilization of his knowledge. He designed the ocean cable ship Faraday; an electric railway and an electric furnace were among others of his inventions; and in this day of electrical progress the autobiography of this great electrician will possess a pertinent and exceptional interest.
Sent to any address on receipt of price.
ELECTRICAL REVIEW,
13 PARK ROW,
NEW YORK.

WE devote special personal attention to reconstruction of CENTRAL STATIONS and placing Electric Light Companies on basis of HIGHEST EARNING CAPACITY.
Any company that is not a genuine success should open correspondence with us; we can assist you. From many years' practical experience, we understand the business.
Address J. H. VAIL, President,
ELECTRICAL AND MECHANICAL ENGINEERING AND TRADING CO., 44 Broad St., New York.

BAKER & CO.,
Importers, Melters and Refiners of
PLATINUM,
408, 410, 412 and 414 N. J. R. R. Ave., NEWARK, N. J.
Platinum in sheet and wire, all sizes, and any degree of hardness. Scrap and native platinum purchased.
NEW YORK OFFICE: 121 LIBERTY STREET.

New York and New England Railroad.
ELECTRICIANS AND OTHERS IN TRAVELING BETWEEN
BOSTON AND NEW YORK
SHOULD ALWAYS USE
THE "NEW ENGLAND LIMITED"
Leaving Either City 3 P. M., Due at the Other 9 P. M., EVERY DAY IN THE YEAR.
Buffet Smokers, Parlor Cars and Coaches. Dining Car between Boston and Willimantic.
TICKET OFFICES:
IN BOSTON: 322 WASHINGTON STREET. STATION, FOOT SUMMER STREET.
IN NEW YORK: 353 BROADWAY. GRAND CENTRAL STATION.
GEO. F. RANDOLPH, Gen'l Traffic Manager.
W. R. BABCOCK, Gen'l Passenger Agent.